# BIRDS USED IN STUDY OF PESTICIDE SIDE-EFFECTS

The stomachs of WA magpies are being examined in a study of the damaging side-effects of pesticides.

The investigation has been going for 18 months and will take three more years.

Research officer, Mr Jim Lane, of the Fisheries and Fauna Department, has taken 100 specimens for the review. Later this month he will go to the Ord River to take more.

Magpies are being used because they will correlate with a similar study using the birds' counterparts in the eastern states, and because the species are territorial and flesh-eating.

Each bird will indicate pesticide poisoning in particular territory.

# DRIED-PEARS GAMBLE LOOKS LIKE A PEACH

MELBOURNE, Today: A $30,000 gamble on the future of dehydrated pears has started to pay off for a Shepparton orchardist.

Mr Bill Brown-Shepherd started drying peeled pears two years ago—and this week he sent his first consignment overseas.

At this stage it is only one ton to Hamburg and a ton to New York, but at last the whole venture is starting to look good.

"Japan is looking interested, too," he said.

Mr Brown-Shepherd started experimenting with dried pears at a time of massive over-production in the Shepparton district.

He designed and built his own dehydrators

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(Gymnorhina).

Emu 68:282. Behaviour of White-b. Magpie.

Emu 68(4) 278-85 (notes on distribution in WA)

FORD, J. (5 Jane has his copy)

Aust Nat Hist 17(2) 51-4. Magpie harem system

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Aust Bird Watcher Ext. of range of B/B Magpie
C. & S. Lawrence 4(3) 82-3 M'71

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Magpie defend. nest after dep. of young
J. N Hobbs.

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W/B mag. at Moorookbark Vic.
Lord & Lawrence.

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Strepera graculina

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ROBERTSON, J.S. Measurements weights & notes on pied c. Aust Bird Bander 7. 54-55

WIMBUSH D J. Studies on the pied C Str. graculina in the Snowy Mountains Emu 69. 72-80.

(19D)B

STATE OF CALIFORNIA
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GAME BULLETIN No. 7 WESTERN AUSTRALIA.

# PESTICIDES: THEIR USE AND TOXICITY IN RELATION TO WILDLIFE

ROBERT L. RUDD and RICHARD E. GENELLY
DEPARTMENT OF ZOOLOGY
UNIVERSITY OF CALIFORNIA, DAVIS

1956

# DDT RESIDUES IN EGGS OF MARSH-INHABITING BIRDS[1]

*Jack Foehrenbach* — Senior Analytical Chemist, New York State Department of Environmental Conservation

*Ghulam Mahmood* — Analytical Chemist, New York State Department of Environmental Conservation

*Dennis Sullivan* — Senior Laboratory Technician, New York State Department of Environmental Conservation

Since 1965, there has been a gradual decline in the number of nests of the clapper rail (*Rallus longirostris*) in several marshes along the south shore of Long Island, New York (Robert Johnson, personal communication). Residues of DDT and its metabolites (DDD and DDE) have been thought to cause bird mortality for a variety of reasons (Hickey, 1969; Stickel and Stickel, 1969). Therefore, it was felt that DDT residue analyses on rail eggs might give an indication of its role in this decline. While collecting the rail eggs, eggs from nests of the black-crowned night heron (*Nycticorax nycticorax hoactli*) and the marsh hawk (*Circus hudsonius*) were also collected. All the eggs were from abandoned nests in 1969. A few of the clapper rail eggs contained embryos, but the rest showed no signs of development. The areas where collections were made are indicated in Figure 1.

Four eggs were collected from each of four clapper rail nests, while two night heron eggs from the same nest and one marsh hawk egg were also collected. The eggs from each nest were considered a separate sample. Each sample was mixed with a drying agent, sodium sulfate and QUSO (9:1), until the eggs were completely homogenized. The homogenate was extracted with petroleum ether for 4 hours, and the extractant was sent through a florisil column (Mills *et al.*, 1963) for cleanup. The analysis was done using a gas chromatograph equipped with an electron capture detector.

The results are given in Table 1. For the rail eggs, the values were rather consistent between the various areas sampled and much lower than those for the marsh hawk and night heron. The values for the marsh hawk and night heron

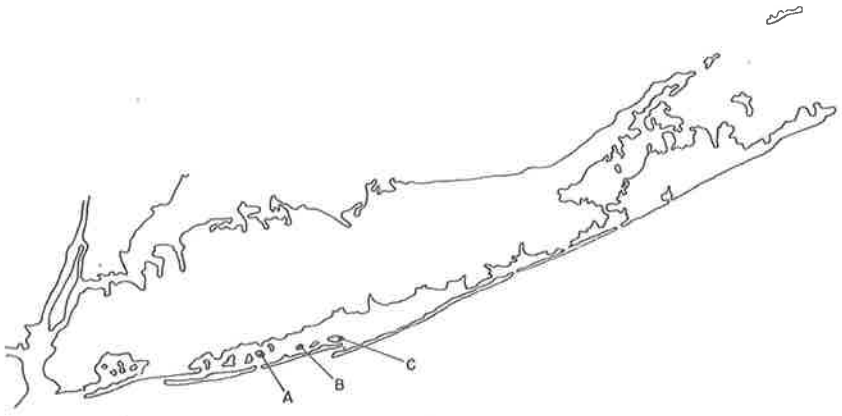



Figure 1. Map of Long Island showing areas where eggs were collected: (A) Hempstead Bay, (B) South Oyster Bay, (C) Captree Island.

[1] Contribution No. 70-9 of the Division of Marine and Coastal Resources. The authors wish to thank John Zarudsky and Harold Knoch for their help in collecting the eggs.

TABLE 1. DDT RESIDUES FOUND IN EGGS OF MARSH-INHABITING BIRDS ON LONG ISLAND, NEW YORK, 1969*

| Species | Location | Date collected | DDT residue in mg/kg | | | |
|---|---|---|---|---|---|---|
| | | | DDE | DDD | DDT | Total |
| Clapper rail ..... | Captree Island | August 1 | 0.096 | 0.115 | 0.150 | 0.361 |
| | Hempstead Bay | August 7 | 0.111 | 0.157 | 0.135 | 0.403 |
| | Hempstead Bay | August 8 | 0.103 | 0.138 | 0.135 | 0.376 |
| | South Oyster Bay | August 8 | 0.101 | 0.119 | 0.151 | 0.371 |
| Marsh hawk ..... | Hempstead Bay | September 9 | 16.9 | 3.93 | 4.57 | 25.40 |
| Black-crowned night heron .... | South Oyster Bay | December 5 | 15.6 | 1.24 | 1.58 | 18.42 |

* For number of eggs in each case, see text.

compared well with data from nearby marshes reported by Woodwell *et al.* who found 13.8 mg/kg of DDT residues in one osprey egg (*Pandion haliaetus*) and 7.13 mg/kg in five eggs of the common tern (*Sterna hirundo*). The higher values for the marsh hawk and night heron eggs, as well as those reported by Woodwell, probably reflect the birds' feeding habits. Ospreys, terns, marsh hawks and herons prey on organisms which are one step higher in the food chain than the rails' prey. Fish are the main food for the osprey, tern and heron, and rodents and birds for the marsh hawk, while the rail feeds primarily on fiddler crabs (*Uca* sp.) and snails (*Melampus bidenatus*). It is well known that DDT is concentrated as it passes through the food chain.

Anderson *et al.* (1969) considered DDE to be the main environmental pollutant causing birds to produce thin-shelled eggs. For eggs of the double-breasted cormorant (*Phalacrocorax auritus*), they found an inverse correlation between shell thickness and DDE residues. The shell thickness decreased from 0.40 to 0.35 millimeter as the DDE concentrations in the eggs rose from about 7 to 27 mg/kg. Although no evidence of thin-shelled eggs was detected in the present study, the values obtained for the marsh hawk and night heron eggs were sufficiently high to cause concern. It should be noted that the heron eggs were abandoned at least 5 months before collection and were subject to intensive microbial action during this time.

Values for the clapper rail were low compared with those for other birds that are thought to be declining because of DDT residues in their eggs. Ames (1966) found 3.0 mg/kg in eggs of a stable osprey colony in Maryland and 5.1 mg/kg in eggs of a declining colony in Connecticut. Excessive reproduction failure occurred in a herring gull (*Larus argentatus*) colony in Wisconsin due to shell-flaking and embryo mortality. DDE residues in nine eggs sampled amounted to 202 mg/kg. These data suggest that perhaps other causes are responsible for the decrease in the numbers of clapper rails in Long Island marshes. During the nesting season, many people visit these marshes for recreational purposes. It is known that several species of birds will abandon their nests if disturbed too often.

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# THE EFFECTS OF PESTICIDES ON FISH AND WILDLIFE

UNITED STATES DEPARTMENT OF THE INTERIOR

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Notes on - Marine life
Pollution - Pesticide card - ordered from Conservation - Pesticides

N° 21 S. McWHIRTER




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## I. INTRODUCTION

During the course of my field study—from 1943 onwards—of the Magpie Lark, *Grallina cyanoleuca* (Latham), in the Coolup district, south-western Australia (Robinson, 1947, 265) I made numerous incidental observations on the populations of the Western Magpie, *Gymnorhina dorsalis* Campbell, resident in the same area. Some results of these studies have already been published (Robinson 1945, 104; 1949, 291) and have been referred to by other authors (Serventy and Whittell, 1951, 363; Armstrong, 1947, 282; Swanberg, 1951, 553).

The unusual character of the nesting cycle, and certain problems of the species which were revealed by these preliminary studies, induced me to make more detailed field investigations. With the generous co-operation of Dr. A. J. Marshall, of the Department of Zoology and Comparative Anatomy of St. Bartholomew's Hospital Medical College, London, it was possible to make this investigation more comprehensive by including parallel studies of the histology of the male gonad.

The Commonwealth Science and Industry Endowment Fund allotted a two-years grant to enable the sustained field

N° 22

S. McWHIRTER



# The Life History of the Western Magpie

## (*Gymnorhina dorsalis*)

By HUGH WILSON, Kalgoorlie, W.A.

In the warm sunny autumn days the Magpies have considerable leisure. For the previous six months their days have been filled with the labour of rearing a family. Now that is past. The young birds hatched in the preceding spring are able to fly and fend for themselves. When the flock feeds together on the ground during the morning and late afternoon the young birds still follow their parents, begging for food. Occasionally some is given to them, but gradually they learn to find all their own food. Towards sunset all the birds leave the ground, and from the trees there is a chorus of song in which all birds join before the flock collects together for the night. Although the flock is the basis of the social life it does not keep together as closely as a flock of [illegible]. Often one or more birds are found [illegible] at a distance from the others [illegible] together.

The [illegible] new nesting [illegible] orthodox 'territorial' way of life, the flocks do not break up. In H. Eliot Howard's description of territory in bird life (1), the flocks break up at the commencement of the breeding season. Each breeding male selects a territory which he defends against other claimants, and he announces his possessions of territory by singing. The territory is defended from trespass by other males of the same species, by 'bluff,' or by actual fighting, and the song serves as a warning to possible trespassers. Later he is joined by the female that becomes his mate, and, when she has learned the boundaries, the pair defend their territory against intrusion from other birds of the same species. Within this territory the birds build their nest and rear their family. The area defended is of sufficient size to provide a food supply for two adults and their nestlings. This mode of life, which is followed by many birds, prevents overcrowding that might endanger the food supply of the young birds. In this paper the word 'territorial' is restricted to such a pattern of life.

The Magpies follow a different way of life. In 1936, before I knew that, I watched a flock, hoping to gain an insight into 'territory' in Australian bird life. The flock contained eight birds, of which two pairs bred that year. They built nests in adjoining jarrah trees about a chain apart. The flock kept intact during the nesting season, and the trees in which the nests were placed were free to all

No. 22

S. McWHIRTER



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march - June - breeding

leaves nest Oct - Nov.

2 months to 1st moult.
12 " " 2ND "
12 " " 3RD "

moult period Oct - Nov to Feb - march.

---

young from nest 12" from beak tip to tail - tip.
weight 6 ounces.

---

Males adult av. 15¾ - 16¾" 10 - 12 oz.
♀ less.

---

Fledgeling - under-surface. dull black - fine white edgings to some feathers. ♂?♀ bill short, leaden - pinkish.

1ST MOULT : under surface mottled grey - brownish bill - leaden. longer. ♂?♀

2nd moult : under-surface - blackish - brown or white edgings to feathers. ♂?♀ but, black-backed birds with none or very little white tips to feathers and leaden bills are all males (?)

3rd moult : under-surface - glossy black. P. 240 nearly-white back. Bill leaden. white base.

4th moult : Full white back (♂) black back (♀)

later moults : as above.

J
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WIMBUSH, D J
Studies on the pied currawong, Strepera graculina in the Snowy Mountains. Emu V.69, 1969.
pp.72-80 figs. refs

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# STUDIES ON THE PIED CURRAWONG *STREPERA GRACULINA* IN THE SNOWY MOUNTAINS

D. J. WIMBUSH

Received 28 March 1967, revised 19 April 1969

*Summary*

The paper describes the results from banding and retrapping, with some associated measurements, in two winter populations of Pied Currawongs in the Snowy Mountains. Yellow gape is an immature character; males are the larger sex and the body weight of mature and immature birds declines during the winter. The age grouping of recoveries is different for the two populations in a way which suggests that breeding birds are rather sedentary and large movements occur only among non-breeding adults and immature birds.

## INTRODUCTION

As in other places (Walsh 1965, Strong 1966), Pied Currawongs in the Snowy Mountains area congregate in large numbers in and round centres of human population during the winter months. When fed, they often become tame and parties of thirty birds or so wrangle for scraps of food in the townships. When it becomes warmer, they leave and, unless a heavy late snowfall occurs, the birds are not seen again in the townships until the following winter. It has been suggested that seasonal altitudinal movements may occur and migration for longer distances may be random (Walsh *op. cit.*, Strong *op. cit.*). This study was to clarify the problem of seasonal movement and by simple measurements to determine growth rates of individuals and the age structure of the populations.

## METHODS

From June to September in 1958, 1959 and 1960, 273 Pied Currawongs were banded at Island Bend, NSW (36°20′S, 148° 30′E) 1300 m a.s.l. During the same months, in 1961 to 1966 inclusive, 404 birds were banded at Waste Point, about 11 km and 300 m lower down the valley of the Snowy River. Trapping was mainly in a 1·8 m cube trap covered with wire netting and having a 0·6 x 0·9 m access door, two or three ground funnels and a roof funnel. A simple drop-trap was also successfully used. During the last two years, the gate in the cube trap was often left open and then pulled shut by a long string. The best bait was a large piece of fatty meat or bone, pegged in the centre of the trap so that it could not easily be moved or broken. Birds which had recently been banded were released when the number of their band had been noted. All others were tied in calico bags, legs and tails protruding. They were then weighed, their tails measured, a metal

R
FR

MYKYTOWYCZ, R
Pasteurella pseudotuberculosis in the Black-backed magpie, Gymnorhina tibicen (Latham), by R. Mykytowycz and D.W. Davies. Reprinted from CSIRO Wildlife Research, V.4 1959. pp.61-68 refs. tables.

R MYCS

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# *PASTEURELLA PSEUDOTUBERCULOSIS* IN THE AUSTRALIAN BLACK-BACKED MAGPIE, *GYMNORHINA TIBICEN* (LATHAM)

By R. Mykytowycz* and D. W. Davies†

[*Manuscript received December* 22, 1958]

*Summary*

A description is given of the disease caused by *Pasteurella pseudotuberculosis* in the Australian black-backed magpie, *Gymnorhina tibicen* (Latham).

Characteristics of the isolated strain are described including its pathogenicity to mice, rabbits, guinea pigs, chickens, and sheep.

## I. Introduction

*Pasteurella pseudotuberculosis* has been isolated from a variety of wild mammals and birds all over the world. Its epidemiology is of considerable interest not only because of the injurious effect of the organism on domestic animals, including poultry, but also because of its potentiality to infect man, from whom it was first isolated. The history of the infection has been comprehensively reviewed by Beaudette (1940).

In Australia *P. pseudotuberculosis* has on occasion been responsible for outbreaks of ovine pyaemic hepatitis. One such outbreak, occurring in Victoria, was investigated by Pullar (1932), who showed that it was associated with an epidemic of pseudotuberculosis in the dense local magpie population. He was concerned primarily with sheep, however, and in the condensed published account of his investigations the symptoms of the bird infection were described only briefly. Recently an outbreak of pseudotuberculosis in black-backed magpies, *Gymnorhina tibicen* (Latham), in the Canberra area provided an opportunity for a more detailed study, the results of which are reported here.

## II. Material and Methods

### (*a*) *Pathological Material*

Sick and recently-dead black-backed magpies provided material for the study. They were sampled in the vicinity of "Gungahlin" in the Australian Capital Territory during the winter and spring of 1956. In addition observations were made on a number of free-living birds in an advanced stage of the disease.

### (*b*) *Inocula*

These were prepared by grinding portions of the affected organs in mortars with alundum and then suspending in isotonic buffered saline which contained 0·5 per cent. gelatin. To some suspensions were added 500 units of penicillin and 4 mg

* Wildlife Survey Section, C.S.I.R.O., Canberra.
† Commonwealth Health Laboratory, Canberra.

Secretary,
Pesticides Residue Advisory Committee,
Dept. of Agriculture,
Jarrah Road,
SOUTH PERTH 6151.

Mr Prince
774/69

17th August, 1970.

Dear Sir,

As advised by Mr Bowen (774/69, March 9th), our Department is in the process of initiating a study of the effects of pollution on wildlife, and to this end we now require information on the following topics if available:-

1. A list of common, technical and trade names of the different types of major insecticides, pesticides and related compounds registered in this State, e.g., Organophosphates; Parathion etc., Organochlorine; D.D.T. etc., and others.

2. Statistics on the quantities of these different compounds used in this State over the last 5 - 10 years if possible.

3. The "location" and quantitative importance of the different users and uses of these compounds, e.g., D.D.T., Agricultural use, Crop spraying; cotton etc. Pasture spraying etc.

Similar information with regard to the different herbicides used is also required if possible. In the event of your inability to provide such information, could you please advise us of the possible source of such information if known.

Yours faithfully,

H.B. SHUGG
Acting Director

S. McWhirter.
Fauna Research,
266 Hay Street,
PERTH. 6000

20.4.72.

Chief Warden of Fauna.
PERTH.

I wish to return to you for your records a license issued to me for the collection of bird specimens for research purposes at the above branch.

As I am leaving the research branch I will have no further use for the license. I am thus returning it, with details of birds taken, before the expiry date specified.

Details of fauna taken follow:-

1. Western Magpie:-

   a) 70 birds taken in S.W. area between Albany Highway and the West Coast.

   b) 3 birds taken in Mingenew area.

   c) 9 birds taken in Mills areas, between Mundaring and Pinjarra.

   Total:- 82.

2. Crow:-

   3 taken on S.W. Highway between Perth and Bunbury.

3. Magpie Lark:-

   5 taken in Mingenew area.

4. Crested Pigeon:-

   1 taken in Mingenew area.

5. Banded Plover:-

   11 taken in Mingenew area.

6. Pied Butcher Bird:-

   1 taken in Mingenew area.

7. Brown Song Lark:-

   14 taken in Mingenew area.

8. Pipit:-

1 taken in Mingenew area.

All of the above birds were taken in connection with the pesticide research programme, now under the direction of Jim Lane.

Records of sampling procedures undertaken in each case are now held by that officer.

S. McWhirter.
T.O. GII 1/2.

FILE NO. 567/69

STANDING COMMITTEE ON FISHERIES

ENVIRONMENTAL POLLUTION COMMITTEE

| | |
|---|---|
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| G. G. T. Harrison | Queensland |
| A. J. Harrison | Tasmania |
| Dr. G. F. Humphrey or nominee | CSIRO |
| Secretariat - Department of Primary Industry | |
| Chairman | A. Dunbavin Butcher |

Mr. E. Scribner,
Department of Fisheries,
G.P.O. Box 30A,
SYDNEY. N.S.W. 2001.

Mr Prince.

8th Sept. 1970.

Dear Sir,

We are currently investigating the possibility of commencing some studies of environmental pollution, and while in Broken Hill for the Arid Zone Conference in May, I was discussing t is problem with a number of people. Terry Launders of the N.S.W. Department of Agriculture mentioned that you were involved with Mr. Scott Gilbert in a project of pesticide monitoring in the Narrabri Irrigation Area, and I would be grateful if you could give me some details on the nature and methcdology of your work.

Yours faithfully,

R. PRINCE.
Fauna Research Officer.

The Divisional Forestry Officer.

1st July, 1971.

Dear Sir,

I would be grateful if you could assist the bearer of this letter Mr. S. McWhirter.

Mr. McWhirter is a Technical Officer in the Fauna Research Section of this Department. He is at present engaged in collecting specimens of the Western Magpie as part of a general survey of pesticide levels in wildlife. It is necessary for him to shoot the birds required in as wide a variety of situations as possible in order for us to ob ain a representative picture of the incidence of contamination, and he may need to obtain some of these from the areas under your control. I would therefore be pleased if you could grant him the necessary permission to carry and use a firearm for this purpose, and advise him of any restrictions in relation to movements in areas of Phytophthora infection or the like.

B.K. BOWEN.
DIRECTOR

THE DIRECTOR.

During the week we will be away with the House of Representatives Select Committee, there will be an opportunity to initiate a pesticide residue screening survey of the agricultural area of the South West as my T/O, Mr. S. McWhirter will not have any work to do in the office.

Basically, I propose that he collect magpies over as wide an area as possible to enable us to establish background levels of contamination at a single point in time.

I require your advice on this proposal because if it is done so as to provide a reasonable coverage, we could finish up with between 250 and 500 specimens for analysis by the Government Chemical Laboratories (3 specimens per bird). Also, the problem might arise as to whether a special permit would have to be issued for him to take the birds.

R. PRINCE.

16th June, 1971.

Original on 774/69.

MR. PRINCE:

On page 25 of this file there is a reference to the monitoring of pesticides in freshwater and estuarine fish and crustacea, and terrestrial animals. I advised the Pesticides Residues Advisory Committee that any monitoring undertaken would be on a limited basis to complement work being undertaken in other institutions.

I would be grateful if you would be Convener of a Departmental Committee to develop a pesticide monitoring programme which will start to set down some base line data. I believe that the other member of the Committee should be Dr. Morrissy with Mr. P. Smith, Clerk, Waterman, acting as Secretary if you find that you need such a service.

I believe that you would do well to use two or three main reference points so that we can use direct comparisons of data obtained by other research workers.

My suggested reference points are:

(1) Department of Fish and Wildlife, Victoria

(2) The Nature Conservancy, U.K. - Dr. Norman Moore
Monks Wood Experimental Station, Abbots Ripton,
Huntingdon, U.K. (I have spoken to Dr. Moore about
this and he has advised that he will be delighted
to provide assistance)

(3) Department of Fish and Game, Resource Building, 1416
Ninth Street, Sacramento, California, U.S.A.
Mr. E. Hunt (Red Hunt) is the person involved in
this work. He is at the Wildlife Investigation
Laboratory, 987 Jedsmith Drive, Sacromento, California,
U.S.A.

The actual analyses would be undertaken by the Government Chemical Laboratories and therefore any system of monitoring must, in practical terms, be one in which our staff can accommodate the collections on the one hand, and in which the Government Chemical Laboratories can accommodate the analyses on the other. As the programme is being developed we will need to have discussions with the Director (or his nominated alternate) of the Government Chemical Laboratories.

I have sent a copy of this minute to Dr. Morrissy and Mr. Smith. I have also sent copies to the Director, Government Chemical Laboratories, and the Secretary to the Pesticides Residues Advisory Committee.

4.3.70

(B.K. Bowen)
DIRECTOR

c.c. ~~Director~~,
~~Government~~ Chemical Labs.

SYMPOSIUM ON PESTICIDES

Ross Lecture Theatre,
University of Western Australia

Wednesday May 21st 1969

MORNING SESSION 9.00 A.M. - 12.45 P.M.

PEST CONTROL BY THE USE OF CHEMICALS

Chairman - C.F.H. Jenkins

| | | |
|---|---|---|
| 9.00 a.m. - 9.10 a.m. | Introduction | |
| 9.10 a.m. - 9.30 a.m. | Pesticides | C.F.H. Jenkins |
| 9.30 a.m. - 9.40 a.m. | The Use of Poisons to Control Mammal and Bird Pests | A.R. Tomlinson |

How many days of Chang in pest... This one

Discussion 9.40 a.m. - 10.10 a.m.

| | | |
|---|---|---|
| 10.10 a.m. - 10.25 a.m. | Integrated Pest Control | B.P. Springett |
| 10.25 a.m. - 10.45 a.m. | Resistance to Pesticides | G.D. Rimes |

Discussion 10.45 a.m. - 11.00 a.m.

Morning Tea 11.00 a.m. - 11.10 a.m.

Chairman - R.C. Rossiter

| | | |
|---|---|---|
| 11.15 a.m. - 11.30 a.m. | Pesticides and Wild Life | B. Bowen |

Discussion 11.30 a.m. - 11.45 a.m.

| | | |
|---|---|---|
| 11.45 a.m. - 12.00 p.m. | Pesticides and International Trade | T.C. Dunne |

Discussion 12.00 p.m. - 12.15 p.m.

| | | |
|---|---|---|
| 12.15 p.m. - 12.30 p.m. | Producing a Pesticide | B. Smith |

Discussion 12.30 p.m. - 12.45 p.m.

Used to be I.C.I. - now Chem Lab research team.

Lunch 1.00 p.m. - 2.00 p.m.

Use of resources - use of money for Chemical development; Biological Research for effects...??

Gunther + Pesticide Residues.



AFTERNOON SESSION 2.00 P.M. - 5.00 P.M.

Dunne Lugg what heard Uren — where are the analyses done ??

PUBLIC HEALTH AND THE USE OF PESTICIDES

Chairman - D.H. Curnow

2.00 p.m. - 2.15 p.m. Analytical Problems Associated with Pesticide Residues — F.E. Uren (Chem labs.)

still years direct toxicity tests.

Discussion 2.15 p.m. - 2.30 p.m.

In some cases

2.30 p.m. - 2.45 p.m. Occupational Hazards in the Manufacture and Use of Pesticides — J.C. McNulty

Sequelae upto 30 yrs latency. possibly.

2.45 p.m. - 3.00 p.m. The Incidence of Pesticide Poisoning — R.A. Joske No info.

Afternoon Tea 3.00 p.m. - 3.15 p.m.

3.15 p.m. - 3.25 p.m. Pesticide Hazards in Children — D. Formby (Parsons jaundice too) ✓

3.25 p.m. - 3.35 p.m. Accumulation of Pesticides in Human Fat — D.H. Curnow

3.35 p.m. - 3.45 p.m. Importance of Pesticides in Home Life — M. Clarke

Discussion 3.45 p.m. - 4.15 p.m.

Springett : good comment !!

Chairman - C.F.H. Jenkins

4.15 p.m. - 4.30 p.m. Registration and Legal Control of Pesticides — W.M. Griffiths (Registration in view of reg d) an interest

Careless — unauthorized vs misuse.

Discussion 4.30 p.m. - 4.45 p.m.

why no biologists consulted Entomologically.

CONCLUSION

(Techniques; Not values in themselves.)

Acute
Morbid
Chronic
} nothing much available on long term effects.

Australian & New Zealand Association
for the Advancement of Science

Western Australian Division

ABSTRACTS - Symposium on Pesticides

"CAN THE USE OF PESTICIDES BE JUSTIFIED" - C.F.H. Jenkins

Following World War II a new era dawned as far as the use of pesticides was concerned, when a host of new insectifides, miticides, herbicides and fungicides appeared on the market.

In the insecticides field, two major groups, the chlorinated hydrocarbons (D.D.T., B.H.C., Dieldrin, etc.) and the organic phosphates (Malathion, Parathion, Diazinon, etc.), took over almost completely from the older chemicals, and newer types, including the carbamates (Carbaryl, etc.), are now gaining in importance.

Most pesticides are potentially dangerous but, because of the residual effect of chlorinated hydrocarbons and the extreme toxicity of some of the organic phosphates, many people recommend the banning of these materials and clamour for more "natural" means of pest control.

Food supply adequacy? One of the most urgent needs at the present time is to feed and clothe the world's population, 50 per cent of which is estimated to be undernourished. This can be attempted in at least three ways. Firstly, by increasing crop acreages, secondly, by the use of improved varieties and, thirdly, by reducing waste.

The Importance of Pesticides in Protecting Food and Fibre Crops

It is estimated that 20% of food and fibre crops are damaged by insects during growth. A further 10% is lost in storage. Losses in Asia are four times those in Europe and three times those in Australia and New Zealand. Control measures in the more sophisticated countries are largely responsible for the differences.

Estimated losses in Australia and New Zealand (details in table):-

| | |
|---|---|
| From insects | $89,000,000 |
| From insects, diseases and weeds | $360,000,000 |

Outlay on insect control by Australian farmers is approximately $8,000,000.

Disease Prevention in Humans and Livestock.

Up to 1961 malaria had been eradicated from areas inhabited by approximately 280,000,000 people. Tsetse fly had been eradicated from 7,000 square miles of Zululand by D.D.T. and B.H.C.

Livestock Losses in Australia

| | | |
|---|---|---|
| Cattle tick | = | $30,000,000 a year |
| Sheep blow fly | = | $20,000,000 a year |

Area Sprayed from the Air in 1966 for Pest Control

| | |
|---|---|
| Australia | 4,000,000 acres approximately |
| Western Australia | 1,000,000 acres approximately |

Weed control would account for about three-quarters of the acreage quoted.

Undesirable Effects of Pesticides

These include:-

(1) Danger to humans, particularly when used by uneducated operators. For example, 3,000 Japanese farmers died between 1953 and 1958 from Parathion poisoning. By contrast, deaths in the U.S.A. have remained constant over a period of 25 years and 60% of the current deaths were due to pre-war chemicals.

(2) Wide spectrum materials kill useful as well as harmful arthropods.

(3) Pesticides may produce resistance in a pest population.

(4) Repeated treatments are usually necessary, and therefore expensive.

(5) The accumulation of residues can create health hazards.

(6) There may be detrimental effects on wild life.

Despite drawbacks, present evidence indicates that the use of pesticides is fully justified and will be necessary for many years to come.

## TABLE SHOWING CROP LOSSES

Estimated losses due to insect pests, diseases and weeds for specific crops in Australia and New Zealand given as follows:-

| Crop | | Losses due to | | | Total |
|---|---|---|---|---|---|
| | | Insect Pests | Diseases | Weeds | Losses |
| Wheat | ,000 tons | 675 | 1,585 | 1,240 | 3,500 |
| | % | 4.9 | 11.5 | 9.0 | 25.4 |
| | $m (U.S.) | 40.5 | 95.1 | 74.4 | 210.0 |
| Sugar Cane | ,000 tons | 2,677 | 4,016 | 2,410 | 9,103 |
| | % | 10 | 15 | 9 | 34 |
| | $m (U.S.) | 25.7 | 38.6 | 23.1 | 87.4 |
| Potatoes | ,000 tons | 74 | 111 | 18 | 203 |
| | % | 8 | 12 | 2 | 22 |
| | $m (U.S.) | 2.9 | 4.4 | 0.7 | 8.0 |
| Brassicas | ,000 tons | 17 | 8 | 9 | 34 |
| | % | 13.6 | 6.4 | 7.0 | 27.0 |
| | $m (U.S.) | 0.7 | 0.4 | 0.4 | 1.5 |
| All Vegetables | ,000 tons | 104 | 138 | 62 | 304 |
| | % | 9.1 | 12.1 | 5.4 | 26.6 |
| | $m (U.S.) | 8.6 | 10.7 | 5.3 | 24.6 |
| Apples | ,000 tons | 46 | 28 | 10 | 84 |
| | % | 10.4 | 6.4 | 2.4 | 19.2 |
| | $m (U.S.) | 3.8 | 2.3 | 0.8 | 6.9 |
| All Fruit | ,000 tons | 83 | 121 | 28 | 232 |
| | % | 8.0 | 11.6 | 2.7 | 22.3 |
| | $m (U.S.) | 7.6 | 10.8 | 2.6 | 21.0 |

Above statistics given by Cramer, H.H. (1967) - Plant Protection & World Crop Production. Eabenfabriken Bayer Ag. Leverkusen.

"POISONING FOR THE CONTROL OF MAMMAL & BIRD PESTS" - A.R. Tomlinson and C.D. Gooding

SUMMARY:

1. There is a need for controlling or managing some troublesome mammals and birds at tolerable levels.

2. In W.A. "management" is applied to troublesome native fauna, while "eradication" or "effective control" are the objectives with introduced mammals and birds.

3. While various methods of management or control are available, poisoning has certain advantages such as quick population reduction, relatively low costs, easy application and direction of application to specific areas.

4. Disadvantages of poisoning include lack of complete specificity, dependance on seasonal and other conditions and on the active voluntary participation of the pests concerned and lack of poisons which result in a completely untroubled death.

5. Dangers of contamination and residual effects are minimised in W.A., although there is a possibility of secondary poisoning from rabbits poisoned with 1080.

6. Successful control of rabbits and dingoes depends on poison ng.

7. Urgent requirements are poisons giving untroubled deaths and with more selectivity, a way of making baits irrestible and a better knowledge of pest species and their environments.

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In dealing with this subject it is necessary to discuss first the reasons why poisons are used to control mammal and bird pests, particularly in Western Australia, and then to deal with poisoning itself.

CONTROL AND MANAGEMENT:

Man's necessary use and exploitation of natural resources means that there is a need for conserving fauna generally, but often there is also a need for controlling or managing some troublesome fauna at tolerable levels.

Control and management of vertebrate fauna are complex problems and the desirable population levels need to be established before decisions are made whether control or management are necessary and the methods to be used. For species which are bordering on extinction or which have a low population, obviously the method must be what we call conservation. For other species capable of maintaining themselves at an acceptable level, no management is required. Where a species increases its numbers or interferes with man's activities in some other way to the point of being "troublesome", some form of control or management to reduce its numbers or restrict its actions to a tolerable state is necessary. This is the duty assigned by legislation to the Agriculture Protection Board.

CONTROL OR MANAGEMENT POLICIES:

In general, two distinct policies are supplied. One which may be called "management" is aimed principally at native species which, for various reasons, should not be eradicated. The problem may be widespread or localised, continuous or only for a limited period, general or only involve certain individuals. The objective is to relieve pressure on or to protect that particular section of man's activity which is being affected, preferably by dealing only with the mammals or birds which are troublesome. Species in this category include dingoes, emus, kangaroos, cockatoos and parrots. The objective of the other policy is "eradication" and is aimed at introduced pests such as rabbits or sparrows. There are no reasons why species such as these should be allowed to become established or should be tolerated in our environment and, while eradication may not be attainable with the methods and resources now available, the ultimate aim is to remove them entirely. In the meantime, the target is set as close to eradication as economically and practically possible, or what is known as "effective" control.

METHODS OF MANAGEMENT:

When mammals or birds are "troublesome" and some limitation of their activities is necessary, there are a number of ways by which this may be done, i.e. -

(a) by "exclusion", including fencing, protective covering and the use of repellents and scaring devices;

(b) by "biological" means, including environmental changes, (involving voluntary movement by the animals), predators, diseases and sterilising agents;

(c) by "mechanical" and "chemical" destruction, including rabbit warren ripping, shooting, trapping and poisoning.

Exclusion, such as fencing, and mechanical destruction have proved very useful but are not always applicable or economical. Biological methods, such as myxomatosis, are excellent, but are rarely available or permanently effective. Because of advantages under some conditions, poisoning is one of the most important measures used.

POISONING:

Some of the advantages of poisoning are -

(a) a relatively large population reduction can be achieved quickly. In vertebrate pest control (such as rabbits) reductions of up to 95% are commonly expected, compared with possibly 50% by mechanical means such as trapping and shooting. This may be very important where the population must be reduced in a short time because of seasonal conditions, etc.

(b) cost is usually cheaper than some other methods. Although in some cases the poison itself may be costly, the labour requirement is usually small and capital expenditure is not great. Some of the mechanical means require costly equipment such as slow moving warren rippers, while rabbit poisoning requires only a light bait layer pulled by a vehicle. Dingo baiting requires only some mechanical bait-making equipment if bulk quantities are wanted, while aeroplanes are relatively cheap to hire for aerial baiting over a big area. Rat and mice poisoning is also cheap and simple.

(c) application is relatively easy. Poison bait distribution is relatively easy with mechanical baitlayers for rabbit poisoning. Aerial baiting makes the distribution of wild dog and dingo baits a simple matter. There are no great problems in the application of rat and mice poisoning.

(d) the application may be directed and confined to specific areas. Unlike biological control where man may be incapable of controlling the spread of predators or diseases once they are released, poison may be applied to specific areas and to specific populations. An environmental change or a method of exclusion may react adversely against many species within an area, whereas by a careful choice of baiting material, careful placement of the baits and time of poisoning, a considerable degree of selectivity may be obtained. In addition, some poisons are now appearing with some specificity, including one for rats and another for starlings.

Disadvantages of poisoning include -

(i) lack of completely specific poisons. This factor probably causes most concern to those who question the use of poisons. It is true that most poisons commonly used are broad spectrum poisons which will kill many species. As already pointed out, considerable specificity may be obtained by careful planning and timing, but the poisoning is still not completely specific. It should be borne in mind that lack of selectivity is of great disadvantage from the aspect of efficiency as well as its possible dangers to man and animals.

(ii) dependance upon suitability of seasonal and other local conditions. The effectiveness of rabbit or wild dogs poisoning may be considerably affected by such factors as the breeding season, heat or cold, rain and wind. A sudden change in weather may leach poison from the bait, render the bait unpalatable or change the movement pattern or feeding habits of the mammals or birds concerned.

(iii) dependance upon the "active voluntary participation" of the mammals or birds concerned. In all types of poisoning except fumigation, where lethal gases are discharged into confined spaces, and the use of tracking dusts, where the poison is ingested during the grooming process, success depends on the mammal or bird voluntarily swallowing the poison which is, in fact, a hostile substance. It is necessary to go to some lengths to make baiting material attractive and to ensure it is placed where it will be readily taken, while natural fears of new objects must be overcome. Preliminary "free feeding" with unpoisoned bait to overcome this fear, is an important but money and time wasting feature of most poisoning processes. (Fortunately the "one-Shot" baiting method has now reduced to one operation in W.A. the four steps previously required for rabbit poisoning.) Lures and attractants are not generally very successful and "active voluntary participation" is a problem requiring careful consideration.

(iv) the lack of poisons which result in completely passive or untroubled deaths. Looking at the issue dispassionately, poisoning is possibly no worse than death from various diseases and from starvation, lack of water, predators, trapping or shooting. However, this aspect is one which must always be taken into account when the necessity for control or management is being decided upon.

specificity - what does this depend upon? → Weed control too

"1080" Birds vs others; triturate in food?

food chain; scavengers??

X toxicity An-Pl.

CONTAMINATION AND RESIDUAL EFFECTS:

Contamination of water and food and residual effects are recognized dangers with all pesticides, but the methods recommended for poisoning in W.A. minimize these dangers. The quantities and types of poisons used and the areas covered afford little, if any dangers of water or food contamination, e.g. poisoned water is not used in natural water supplies, but only in troughs or containers which are emptied out afterwards. Reports of deaths of native fauna are rare, but 1080 does present a possibility of secondary poisoning and many foxes are killed by eating poisoned rabbits. However, trapping and shooting of rabbits is prohibited when 1080 is used, while property owners are warned to keep domestic dogs and cats away.

DISCUSSION:

Poisoning is a most important measure in the necessary control or management of pest mammals or birds to tolerable levels. Successful control of rabbits and wild dogs is certainly dependant on poisoning. One problem which arises is to ensure that the desired result is obtained with the pest concerned, but with as little harm as possible to anything else.

The most urgent requirements for poisoning are poisons which give a completely passive death and have more selectivity, some way of making baits irresistible and a better knowledge of pest species and their environments.

There are possibilities in the future with other methods, especially with biological control, but, until they are developed, poisoning is necessarily one of the major methods of control and management.

Cerling MAN. on activities!

"INTEGRATED PEST CONTROL" - B.P. Springett.

The problems of pollution, resistance and quarantine in relation to pesticides are raised. The modern wide definition of integrated control is given and equated with pest management.

The array of new methods and materials in man's arsenal for use against pests is described. It includes pathogens (virus, bacteria); man-made substances, usually produced by the animals (pheromones); or effects induced into animal populations (sterility); biological control using parasites and predators; cultural practices using new crop treatments and new crop materials; and selective chemicals which affect target organisms only.

Because of the large array of weapons, questions of strategy are now important. The strategy and application of examples of each type of weapon are described.

If wholesale pollution of the human environment is to be avoided, control of insect pests must use these new weapons. There is an urgent need for more research on whole agro-ecosystems, for consideration of whole system effects and the correct utilisation of economic damage levels.

"PESTICIDES AND WILD LIFE" - B.K. Bowen.

Problems of pesticides and wildlife centre around the following points:

1. Most pesticides are non-selective.
2. The manner of use is often non-selective, e.g. broadcasting.
3. Many kinds of pesticides are chemically stable (especially the chlorinated hydrocarbons) and survive in soil water and tissues.
4. Associated with this is the biological transfer of toxic chemicals, e.g. through food chains, so that the greatest effect may be felt at a stage in a food chain furthest from the intended one.
5. The effects on non-target organisms may be either direct (kills) or indirect (lowering fertility) and may turn up in areas geographically distant to the target area.

In Western Australia the main problem is lack of data. Only circumstancial evidence of minor kills have been reported, e.g. the death of various species of birds after the application of fertiliser containing chlordane to playing fields.

What is needed is:

1. Recognition that fish and wildlife should come into consideration when biocides are being registered and their use controlled.
2. Adequate facilities to monitor fish and wildlife for residues.

"PESTICIDES AND INTERNATIONAL TRADE" - T.C. Dunne.

The Food and Agriculture Organisation of the United Nations agreed, in 1961, to act as the international centre for the collection and consideration of information on pesticides used in agriculture. The objective was to evolve measures designed to eliminate the hazards which could arise in the course of the manufacture, distribution and usage of pesticides and from pesticide residues in foods.

The urgent problem of determining safe and acceptable standards for pesticide residues in foodstuffs in international trade is difficult because of the increasing number of pesticides available and the limitations in the knowledge of the toxicology of many pesticides and the varying agricultural needs of different exporting countries.

"PROBLEMS IN CHEMICAL ANALYSIS OF PESTICIDES" - F.E. Uren.

The following matters will be discussed:-

the extraction of pesticide residues from various materials,

the various methods of detection and determination and confirmatory tests of pesticides including infra red adsorption, paper, thin layer and gas chromatography.

Reference to problems of nomenclature and contamination of samples and reagents will be made.

"PESTICIDE HAZARDS IN CHILDREN" - D.J. Formby.

A six-year series of poisoning due to Pesticides necessitating admission to Princess Margaret Hospital will be presented.

These cases will be considered in relation to other causes of childhood poisoning.

The clinical problems will be briefly dealt with and experience world-wide touched upon.

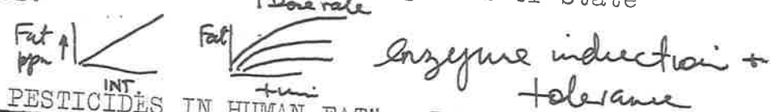
"IMPORTANCE OF PESTICIDES IN HOME LIFE" - Miles de C. Clarke.

This talk will be on a variety of topics selected from the following:-

a. Marketing and containers
b. Availability in the home
c. Poor indication of toxicity
d. First Aid measures
e. Affect on pets
f. General symptoms and signs of poisoning
g. Skin conditions

"REGISTRATION AND LEGAL CONTROL OF PESTICIDES" - W.M. Griffiths.

Governmental procedures and requirements for the registration of pesticides, with an account of legal controls applicable to them in Western Australia are described, with particular reference to the functions and powers of State Health authorities.




"ACCUMULATION OF PESTICIDES IN HUMAN FAT" - D.H. Curnow.

Fiftyeight samples of human adipose tissue taken at the Royal Perth Hospital in 1965-66 were analyzed for organochlorine pesticides. The samples were taken from persons who had lived in Western Australia and who had no known occupational exposure to pesticides. The mean concentration of total DDT-derived material in these samples was 9.5 p.p.m.[1] This finding is compared with the Melbourne study of Bick[2] where the mean level was 1.8 p.p.m. in 1965. The corresponding figures for dieldrin content are 0.67 p.p.m. in Perth (12 subjects) and 0.05 p.p.m. in Melbourne (53 subjects). The levels of DDT-derived material are about the same in the Perth study as in similar studies in the U.S.A., rather more than in U.K. studies but about half the levels found in Israel. The Perth dieldrin levels are high compared with other populations.

methods of est reported

1. Wassermann, M., Curnow D.H., Forte P.N. and Groner Y. (1968) Int. J. Indust. Med. & Surg. 37, 295.
2. Bick M. (1967) Med. J. Aust. 1, 1127.

80% of the sample >5 ppm

"PRODUCING A PESTICIDE" - B. Smith.

An outline is given of the ways by which a new pesticide reaches the market. The steps are:-

initial preparation of a new chemical,
biological screening,
small plant trials,
large scale field trials and
final marketing.

During this progression a suitable and economical method of manufacture must be developed and a plant erected to produce the pesticide.

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ABSTRACTS - Symposium on Pesticides

"PESTICIDE RESISTANCE" - G.D. Rimes

The ability of various arthropods to develope resistance to pesticides has become a widespread phenomenon in recent years. This inherited ability has limited the expectant life of modern insecticides in many cases to a few years.

For an insect population to develope resistance a proportion of the insects must possess the pre-adaptive ability or resistant gene. Once the appropriate insecticide is applied selection occurs and only this faction of the population survives. Repeated insecticide applications result in a completely resistant strain. The classical way to induce resistance is to contaminate as wide an area as possible with a residual insecticide which persists in killing a high proportion of the insects for a long period after application.

The biochemistry of the resistance mechanisms are fairly well known. Resistant insects detoxify insecticides by certain enzymatic processes. Synergists are non-insecticidal materials which block this detoxification mechanism and allow the insecticide to function.

Cross resistance is often encountered in the field and is the ability of the insect to withstand a pesticide to which it has not been previously exposed. For this to occur a related chemical must have been previously used although anomalies have been reported. The detoxification mechanisms developed for one pesticide is efficient in dealing with the related compound. Unexpected cross resistance may also be explained by accelerated excretion or developed nerve insensibility.

Once resistance to a pesticide has been developed it is only rarely that reversion takes place and the insecticide has any future economic application. The original pre-adaptive ability of the population exists in a more selected state and resistance will occur more rapidly than in the first instance. Resistance is a 'One-Way Street'.

done rates !!
escape from treated!! environment + selection within population
isolate - selection
Now isolate - immigration swamps selection effect
Sampling from pop^n - founders ♀ or without genetic potential; no further mutation.
Argentine ant :- selection ? asexual forms only killed outside the nest - minimal selection on sexual forms !!

Values of usage

Criteria for assessment:

mention w/, ecological + other considerations.

no biologist or counter or referable
except entomology.

Applications: techniques for assay
regular usage

Biologic tests
non comparable
rats only

Short
for
Critical
evaluation only

what effect on wildlife
can thus be assessed except
under widespread field use.

FILE NO. 567/69

STANDING COMMITTEE ON FISHERIES

ENVIRONMENTAL POLLUTION COMMITTEE

| | |
|---|---|
| C. G. Setter | Department of Primary Industry |
| A. Dunbavin Butcher | Victoria |
| Dr. D. D. Francois | New South Wales |
| G. G. T. Harrison | Queensland |
| A. J. Harrison | Tasmania |
| Dr. G. F. Humphrey or nominee | CSIRO |
| Secretariat - Department of Primary Industry | |
| Chairman | A. Dunbavin Butcher |

MARPLE SAMPLING

CASTLE
SUSPENSION FILING
SPECIALLY MANUFACTURED BY
TWINLOCK CRYSTALFILE

CASTLE
OFFICE EQUIPMENT

Locust Spraying – APB

Lake Grace area

Tim STEPHENS DAFO, APB : information

Using currently Fenitrothion – is believed more effective than Malathion – (malathion used in Magpie/Mingenew location 197. ).

Method is misting using 300 mls per ha of a 1.28 kg/litre active ingredient Fenitrothion mix.

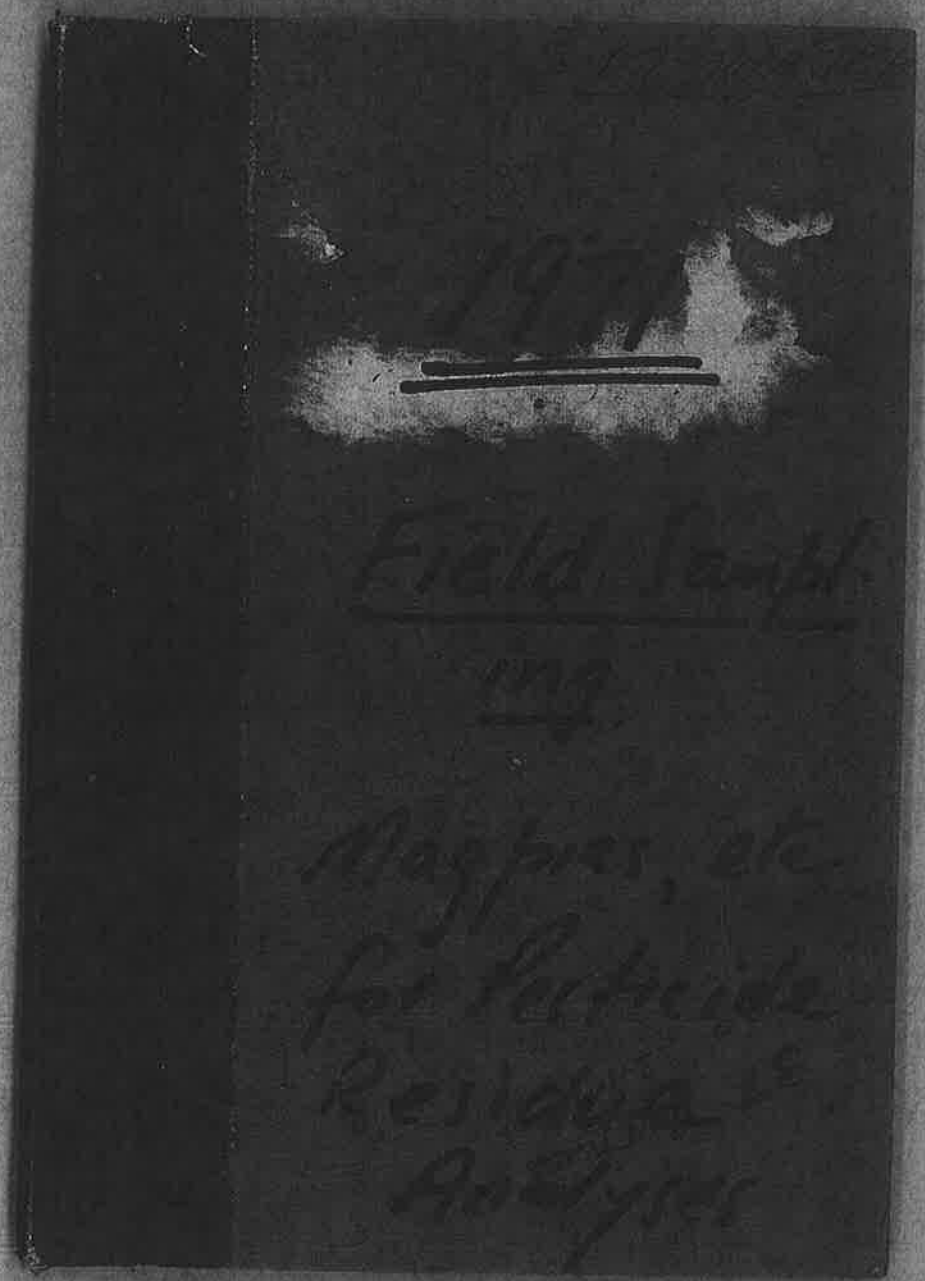
c. Dec 82 note.

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Mr Chris SHARP in "Pesticide Section"
?? Public Health
→ Ag Dept ←

We write up rough notes from phone conversation in my "pesticide supply file".

3/7/87.



STATE FOREST.

NUMBER :- 1 ✓

DATE :- 30-6-71

TIME :- 1130 HRS.

SPECIES :- GYMNORHINA dorsalis.

SEX :- ♂

AGE :- 1ST year (8-9 mth)

COLLECTOR :- S. McWHIRTER

HOW COLLECTED :- SHOT

SAMPLES TAKEN :- 1. MUSCLE
2. LIVER.

OVERALL LENGTH :- 16½"

TOTAL WEIGHT :- —

LOCATION :-

CNR CANNING RD and GLEN-ISLA ROAD. (PICKERING BROOK)

NOTES :-

8 BIRDS IN FAMILY GROUP. 2 appeared to be old males. Remainder ♀ & young birds. Nearest family 2 miles away (east)

STATE FOREST.

| | |
|---|---|
| N° | 2 ✓ |
| DATE | 30·6·71 |
| TIME | 11·30 HOURS |
| SPECIES | G.d. |
| SEX | ♀ |
| AGE | 2ND YEAR. |
| COLLECTOR | S. McWHIRTER |
| HOW COLLECTED | SHOT |
| SAMPLES TAKEN | 1. MUSCLE |
| | 2. LIVER |
| OVERALL LENGTH | $15\frac{5}{8}$" |
| TOTAL WEIGHT | — |
| LOCATION | Corner Canning Rd + Tyler Park Rds. (Pickering Brook) |
| REMARKS | As for N°1. |

PASTURE.

| | |
|---|---|
| N° | 3. ✓ |
| DATE | 3.7.71 |
| TIME | 11·50 HRS. |
| SPECIES | G.d. |
| SEX | ♂ |
| AGE | 4+ years |
| COLLECTOR | S. McWHIRTER |
| HOW COLLECTED | SHOT |
| SAMPLES TAKEN | 1. MUSCLE |
| | 2. LIVER |
| OVERALL LENGTH | 15½" |
| TOTAL WEIGHT | 290 gms. |
| LOCATION | S.W. Highway, 4 miles north of Pinjarra. |
| REMARKS: | Bird on own. black band on tail 1" wide. 2 of 3 bastard feather half white. |

| | |
|---|---|
| N° | 4. |
| DATE | 3.7.71 |
| TIME | 12.40 HRS |
| SPECIES | CROW. |
| SEX | ♂ (by dissection) |
| AGE | Adult |
| COLLECTOR | S. McWHIRTER |
| HOW COLLECTED | SHOT |
| SAMPLES TAKEN 1. | MUSCLE |
| 2. | LIVER |
| OVERALL LENGTH | 20.5" |
| TOTAL WEIGHT | 640 gms |
| LOCATION | 1 mile north of Ranjana S.W. Highway. |

PASTURE

REMARKS. Bird alone. Wing span 40½".

| | |
|---|---|
| N° | 5. ✓ |
| DATE | 3.7.71 |
| TIME | 13.30 HRS |
| SPECIES | g.d. |
| SEX | ♂ |
| AGE | 4+ yrs. |
| COLLECTOR | S. McWHIRTER |
| HOW COLLECTED | SHOT |
| SAMPLES TAKEN 1. | MUSCLE |
| 2. | LIVER |
| OVERALL LENGTH | 16½" |
| TOTAL WEIGHT | 290 gms. |
| LOCATION | 3½ north of Waroona S.W. Highway. |

PASTURE

REMARKS. 2 of 3 bastard feather half white. Black band on tail 1½" wide. Band on. Family group only 3 birds in immediate area (nearest family 2 miles).

| | |
|---|---|
| N° | 6. ✓ |
| DATE | 3.7.71 |
| TIME | 13.40 hrs. |
| SPECIES | H.d. |
| SEX | ♀ |
| AGE | 4 yrs. |
| COLLECTOR | S. McWHIRTER |
| HOW COLLECTED | SHOT |
| SAMPLES TAKEN 1 | MUSCLE |
| 2. | LIVER |
| OVERALL LENGTH | 16" |
| TOTAL WEIGHT | 290 gms. |
| LOCATION | 2 mls. north of Wahroona. S.W. Highway. |

PASTURE

REMARKS: Family group of 6. Very small amount of white on bastard wing feathers. Black band 1½" on tail. Upper beak white for 3/4 of length.

| | |
|---|---|
| N° | 7. |
| DATE | 3.7.71 |
| TIME | 14.30 hrs. |
| SPECIES | CROW. |
| SEX | ♀ (by diss.) |
| AGE | Mature |
| COLLECTOR | S. McWHIRTER |
| HOW COLLECTED | SHOT |
| SAMPLES TAKEN 1 | MUSCLE |
| 2 | LIVER (1 pc fat) |
| OVERALL LENGTH | 19 3/4" |
| TOTAL WEIGHT | 495 gms. |
| LOCATION | 3 mls South of Yarloop. |

PASTURE

REMARKS. Wing 39". Bird with group of 3 magpies. No magpies taken.

| | |
|---|---|
| N° | 8. |
| DATE | 3.7.71 |
| TIME | 14.50 hrs. |
| SPECIES | C.d. |
| SEX | ♂ |
| AGE | 4 to 5 yrs. |
| COLLECTOR | S. McWHIRTER |
| HOW COLLECTED | SHOT |
| SAMPLES TAKEN | 1. MUSCLE |
| | 2. LIVER |
| OVERALL LENGTH | 16 3/4" |
| TOTAL WEIGHT | 325 gms. |
| LOCATION | 5 mls. south of Yarloop. |

PASTURE

REMARKS: Full white back. Back white for 3/4 length. black band 1" on tail. white on 2 of bastard wing feathers. Family group of 6. Family group of 8 1/2 mile North.

| | |
|---|---|
| N° | 9. |
| DATE | 3.7.71 |
| TIME | 15.55 hrs. |
| SPECIES | CROW. |
| SEX | ♂ by diss |
| AGE | Adult. |
| COLLECTOR | S. McWHIRTER |
| HOW COLLECTED | SHOT |
| SAMPLES TAKEN | 1. MUSCLE |
| | 2. FAT, 3. LIVER. |
| OVERALL LENGTH | 20 1/4" |
| TOTAL WEIGHT | 700 gms. |
| LOCATION | 7 miles south of Roelands S.W. Highway |

PASTURE

REMARKS: Wing span 40 1/2"

IRRIGATED PASTURE.

| | |
|---|---|
| N° | 10. |
| DATE | 3.7.71 |
| TIME | 16·30 hrs |
| SPECIES | g.d. |
| SEX | ♀ |
| AGE | 3rd Moult. |
| COLLECTOR | S. McWHIRTER |
| HOW COLLECTED | SHOT |
| SAMPLES TAKEN | 1. MUSCLE<br>2. LIVER |
| OVERALL LENGTH | 15 1/2" |
| TOTAL WEIGHT | 290 gms. |
| LOCATION | 1 1/2 miles south of Waterloo - Waterloo Dandaraga Road. |

REMARKS: 1 bastard wing feather white. Beak white 3/4"

IRRIGATED PASTURE.

| | |
|---|---|
| N° | 11. |
| DATE | 3.7.71 |
| TIME | 17.15 hrs. |
| SPECIES | g.d. |
| SEX | ♂ |
| AGE | 4+ yrs. |
| COLLECTOR | S. McWHIRTER |
| HOW COLLECTED | SHOT |
| SAMPLES TAKEN | 1. MUSCLE<br>2. LIVER |
| OVERALL LENGTH | 16 3/4" |
| TOTAL WEIGHT | 325 gms. |
| LOCATION | 1/2 mile north Dandaraga - Dandaraga Bunbury Rd. |

REMARKS: Beak white for 3/4 length. Black band 1" wide. White on 2 of bastard wing feathers.

PART CLEARED (PASTURE)

| | |
|---|---|
| Nº | 12. |
| DATE | 3.7.71 |
| TIME | 17.30 |
| SPECIES | G.d. |
| SEX | ♀ |
| AGE | 3rd Moult. |
| COLLECTOR | S McWHIRTER |
| HOW COLLECTED | SHOT |
| SAMPLES TAKEN | 1. MUSCLE |
| | 2. LIVER |
| OVERALL LENGHT | 15 1/2" |
| TOTAL WEIGHT | 312 gms. |
| LOCATION | 1/2 mile South of Dardanup - S.W. Highway. |

REMARKS: Beak white for 1/2 length. No white on pectoral wing feathers. Tail band 1 1/2" wide.

TOWNSITE

| | |
|---|---|
| Nº | 13. |
| DATE | 4-7-71 |
| TIME | 07.30 |
| SPECIES | G.d. |
| SEX | ♂ |
| AGE | 4+ yrs |
| COLLECTOR | S. McWHIRTER |
| HOW COLLECTED | SHOT. |
| SAMPLES TAKEN | 1. MUSCLE |
| | 2. LIVER |
| OVERALL LENGTH | 17 1/4 |
| TOTAL WEIGHT | 290 gms |
| LOCATION | 1/2 mile West Collie on Coalfields H'way. |

REMARKS: Two birds (♂) Remainder located 1/2 mile away. No unknown. White on 2 of Pectoral wing feathers. 1" black on tail 3/4 white. Full white back, beak

| | |
|---|---|
| N° | 14. |
| DATE | 4-7-71 |
| TIME | 0830 |
| SPECIES | 6.d. |
| SEX | ♂ |
| AGE | 4+ |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | SHOT |
| SAMPLES TAKEN 1. | MUSCLE |
| 2. | LIVER |
| OVERALL LENGTH | 16¼ |
| TOTAL WEIGHT | 280 GMS |
| LOCATION | 5 mile South. East coast on ~~Mumballup~~ ~~Road~~ Cardiff Road. |
| REMARKS | With 6 other birds. Recent family 1 mile, white on 2 of B.W.F. 1" black on tail. |

| | |
|---|---|
| N° | 15. |
| DATE | 4.7.71 |
| TIME | 09.50 HRS |
| SPECIES | 4.d. |
| SEX | ♂ |
| AGE | 4+ yrs |
| COLLECTOR | S. McWHIRTER |
| HOW COLLECTED | SHOT |
| SAMPLES TAKEN 1. | MUSCLE |
| 2. | LIVER |
| OVERALL LENGTH | 16 1/4" |
| TOTAL WEIGHT | 350 gms. |
| LOCATION | 1.2 mls South of Mumballup on Mumballup - Donnybrook Rd. |
| REMARKS: | white on 2 of outstd wing feathers. 1" black band on tail. ~~Tail~~ Beak white 3/4 length. 3 birds in family |

PASTURE

PASTURE

| | |
|---|---|
| N° | 16. |
| DATE | 4.7.71 |
| TIME | 10.20 hrs. |
| SPECIES | G.d. |
| SEX | ♂ |
| AGE | 5 to 6 yrs. |
| COLLECTOR | S. McWHIRTER |
| HOW COLLECTED | SHOT |
| SAMPLES TAKEN | 1. MUSCLE |
| | 2. LIVER |
| OVERALL LENGTH | 16 1/4" |
| TOTAL WEIGHT | 295 gms. |
| LOCATION | 8.5 mls west south of Mumballup. Mumballup – Donnybrook Rd. |

REMARKS: white on 2 bastard feathers. 1 wide black band. Beak horny + white for 3/4" length. Tail white back. 3 nyphes in immediate area.

PASTURE

| | |
|---|---|
| N° | 17. |
| DATE | 4.7.71 |
| TIME | 10.40 hrs. |
| SPECIES | G.d. |
| SEX | ♀ |
| AGE | 3rd moult. |
| COLLECTOR | S. McWhirter. |
| HOW COLLECTED | Shot. |
| SAMPLES TAKEN | 1. MUSCLE |
| | 2. LIVER |
| OVERALL LENGTH | 16 1/4" |
| TOTAL WEIGHT | 295 gms. |
| LOCATION | ~~126~~ Junction of S.W. Highway and Mumballup Donnybrook Rd. |

REMARKS: Beak horny + white for 3/4 length. No white on bastard wing feathers. Black band 2" wide on tail. 4 black spots on white of upper wing. Group of 4. Bands.

| | |
|---|---|
| N° | 18. |
| DATE | 4.7.71 |
| TIME | 11.30 HRS |
| SPECIES | g.d. |
| SEX | ♂ by dies. |
| AGE | 3rd Moult. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. MUSCLE |
| | 2. LIVER |
| OVERALL LENGTH | 16 1/4" |
| TOTAL WEIGHT | 262 gms. |
| LOCATION | 12.1 mls from Donnybrook - Donny brook - Capel Rd. |

PASTURE.

REMARKS: Black band on tail 1½" wide. White on 2 of bastards wing feathers. Right leg only stump. Faded ~~white~~ black spots on wings. Back turning white (dappled)

| | |
|---|---|
| N° | 19. |
| DATE | 4.7.71 |
| TIME | 12.10 hrs. |
| SPECIES | g.d. |
| SEX | ♂ |
| AGE | 3rd Moult. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. MUSCLE |
| | 2. LIVER |
| OVERALL LENGTH | 16 3/8" |
| TOTAL WEIGHT | 292 gms. |
| LOCATION | 1 mile donnybrook side of capel. Donney brook Capel Rd. |

PASTURE

REMARKS: Back white slightly dappled. White on 2 of bastard wing feathers. Back white ¼ length band on tail 1½" wide. Family of 4.

PASTURE

| | |
|---|---|
| N° | 20. |
| DATE | 4.7.71 |
| TIME | 12.40 hrs. |
| SPECIES | y.d. |
| SEX | ♀ |
| AGE | 1st Moult |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. MUSCLE |
| | 2. LIVER |
| OVERALL LENGTH. | 15 1/2" |
| TOTAL WEIGHT. | 270 gms. |
| LOCATION | Russell Highway 2·9 m South Russelleton ~~side of road.~~ |

REMARKS: Beak leaden. Black band on tail 2" wide. Speckled chest. Family of 6.

PASTURE

| | |
|---|---|
| N° | 21. |
| DATE | 4.7.71 |
| TIME | 13.55 hrs |
| SPECIES | y.d. & ♀ |
| SEX | |
| AGE | 1st Moult |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot. |
| SAMPLES TAKEN | 1. MUSCLE |
| | 2. LIVER |
| OVERALL LENGTH | 16 1/4" |
| TOTAL WEIGHT | 310 gms |
| LOCATION | 9 mls south of Russelton on Yallingup Rd. 1 mile east. ? |

REMARKS: Family of 11. One shot. Black band on tail 2 1/2" wide. Beak grey. Black spots on white of upper wing.

| | |
|---|---|
| N° | 22. |
| DATE | 4.7.71 |
| TIME | 14·05 hrs. |
| SPECIES | G. d. |
| SEX | ♂ |
| AGE | 4+ yrs |
| COLLECTOR | D. McWhirter. |
| HOW COLLECTED | Shot. |
| SAMPLES TAKEN | 1. MUSCLE |
| | 2. LIVER |
| OVERALL LENGTH | 16 ½" |
| TOTAL WEIGHT | 310 gms |
| LOCATION | 10.9 south of Busselton on Yallingup Rd. 2 mls. East. |

PASTURE

REMARKS: White on 2 Bastard feathers. Black band on tail 1 1/4" wide. Tail feathers - white on white, black on black. Beak white for ¾ length.

| | |
|---|---|
| N° | 23. |
| DATE | 4.7.71 |
| TIME | 14·55 hrs. |
| SPECIES | G. d. |
| SEX | ♂ by dissn |
| AGE | 1st moult. |
| COLLECTOR | D McWhirter. |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. MUSCLE |
| | 2. LIVER |
| OVERALL LENGTH | 16 3/8" |
| TOTAL WEIGHT | 280 gms. |
| LOCATION | 0.9 mls. Margaret River side of Yallingup. |

REMARKS: Beak leaden. Black band 2 ¾" on tail. Black spots on white of upper wing.

| | |
|---|---|
| N° | 24. |
| DATE | 4.7.71 |
| TIME | 15.05 hrs |
| SPECIES | g.d. |
| SEX | ♀ by diss. |
| AGE | 3rd |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. MUSCLE |
| | 2. LIVER |
| OVERALL LENGTH | 16" |
| TOTAL WEIGHT | 335 gms. |
| LOCATION | 1 ml. Margaret River side of Gallingups. |

PASTURE

REMARKS: white on 2 of bastard wing feather. Black ~~spots~~ on white of upper wing. Black band on tail 1¾" wide. Group of 4.

| | |
|---|---|
| N° | 25. |
| DATE | 4.7.71 |
| TIME | 17.00 |
| SPECIES | g.d. |
| SEX | ♀ by diss |
| AGE | 3rd Moult. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. MUSCLE |
| | 2. LIVER |
| OVERALL LENGTH | 16½" |
| TOTAL WEIGHT | 314 gms. |
| LOCATION | Mammoth Cave Turn off on Karridale – Margaret River Rd. |

REMARKS; About 10 in family Black band on tail 2 3/8" No white on bastard wing feathers. Beak white for ½ length.

| | |
|---|---|
| N° | 26 |
| DATE | 4.7.71 |
| TIME | 17.00 |
| SPECIES | G. d. |
| SEX | ♂ dies. |
| AGE | 3rd Moult |
| COLLECTOR | A. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. MUSCLE 2. LIVER |
| OVERALL LENGTH | 17" |
| TOTAL WEIGHT | 315 gms. |
| LOCATION | Mammoth Cave turn off on Kurtsdale - Margaret River Rd. |

REMARKS: About 10 in family. Black band on tail 2½" wide. Beak white for ½ length.

| | |
|---|---|
| N° | 27. |
| DATE | 5.7.71 |
| TIME | 9.15 hrs |
| SPECIES | G. d. |
| SEX | ♂ |
| AGE | 4 + yrs |
| COLLECTOR | A McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. MUSCLE 2. LIVER |
| OVERALL LENGTH | 17" |
| TOTAL WEIGHT | 302 gms |
| LOCATION | 2.9 mls towards Nannup from Alexander Bridge |

REMARKS: White on 2 bastard wing feathers. Black band on tail 1¼". Full white back. Beak white for ¾ length. About 6 birds in family. Taken.

MOISTURE

PASTURE / S.F.

| | |
|---|---|
| N° | 28. |
| DATE | 5.7.71 |
| TIME | 11.32 hrs |
| SPECIES | y.d. |
| SEX | ♀ by diss. |
| AGE | 3 to 4 Mo. old. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. MUSCLE |
| | 2. LIVER |
| OVERALL LENGTH | 15½" |
| TOTAL WEIGHT | 302 gms. |
| LOCATION | 4 mls. Bridgetown side of Nannup Rd. on Main (Brockman Hwy) |

REMARKS: Black band on tail 2¼" wide. Beak white for ½ length. 4 black spots on white of upper wing. White on 1 belated wing feather.

PASTURE

| | |
|---|---|
| N° | 29. |
| DATE | 5.7.71 |
| TIME | 12.06 |
| SPECIES | y.d. |
| SEX | ♀ by diss. |
| AGE | 2nd Moult |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. MUSCLE |
| | 2. LIVER |
| OVERALL LENGTH | 15½" |
| TOTAL WEIGHT | 242 gms. |
| LOCATION | 8 mls Nannup side of Bridgetown on main road Brockman Hwy |

REMARKS: No white bastard wing feathers. Black band on tail 2¾". 8 in family 2 taken

| | |
|---|---|
| N° | 30. |
| DATE | 5.7.71 |
| TIME | 12.15 hrs |
| SPECIES | ~~Q Juv.~~ ♀ ♀. |
| SEX | ♀ by diss |
| AGE | 4 yrs. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. MUSCLE |
| | 2. LIVER |
| OVERALL LENGTH | 16 1/4" |
| TOTAL WEIGHT | 298 gms. |
| LOCATION | 8 mls nannuh side of Bridgetown on Main road. |

PASTURE

REMARKS: 8 in family 2 taken. Black band on tail 1 3/8" wide. Beak white for 3/4 length. Faded black spots on white of upper wing white on 2 bastard wing feathers.

| | |
|---|---|
| N° | 31. |
| DATE | 5.7.71 |
| TIME | 13.06 |
| SPECIES | ♀. ♂. |
| SEX | |
| AGE | 4+ yrs. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. MUSCLE |
| | 2. LIVER |
| OVERALL LENGTH | 16" |
| TOTAL WEIGHT | 305 gms. |
| LOCATION | 2 mls north of Balmoyhu on S.W. Highway. |

PASTURE S/F.

REMARKS: 1 1/2" black band on tail. White on 2 bastard wing feathers. Full white back. Beak white for 3/4 length. 8 in family.

| | |
|---|---|
| No | 32. |
| DATE | 5.7.71 |
| TIME | 15.05 |
| SPECIES | Y. d. |
| SEX | ♂ |
| AGE | 4 yrs. |
| COLLECTOR | S.M. Wheeler |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle 2. Liver |
| OVERALL LENGTH | 16 5/8" |
| TOTAL WEIGHT | 317 gms. |
| LOCATION | 12 mls from Budgeta Boyup Brook Rd. |

PASTURE

REMARKS: Black band on tail 3/4" wide. Beak white 3/4 length white on 2 contrast wing feathers. Back nearly white. 6 magpies in family.

| | |
|---|---|
| No | 33. |
| DATE | 5.7.71 |
| TIME | ~~15.15~~ |
| SPECIES | Y. d. |
| SEX | ♂ [redacted] |
| AGE | 5 to 6 |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot. |
| SAMPLES TAKEN | 1. Muscle 2. Liver |
| OVERALL LENGTH | 16" |
| TOTAL WEIGHT | 265 gms. |
| LOCATION | 13.5 mls from Bridgetown Boyup Brook Rd. |

PASTURE

REMARKS: Full white beak. Beak white 3/4 length Black band 3/4" wide. White on 2 contrast wing feathers.

PASTURE
BUSH LAND

| | |
|---|---|
| Nº | 34. |
| DATE | 5.7.71 |
| TIME | 16-00 |
| SPECIES | G.d. |
| SEX | ♂ |
| AGE | 4+ |
| COLLECTOR | L. McWhirter. |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle |
| | 2. Liver. |
| OVERALL LENGTH | 16 1/4" |
| TOTAL WEIGHT | 322 gms. |
| LOCATION | Palgarup Town Site |

3 birds in immediate area 2 taken.

REMARKS: Full white back white on 2 basterd wing feathers. Black band 1 3/8" wide. Beak white for 1/2 length

PASTURE
BUSHLAND

| | |
|---|---|
| Nº | 35. |
| DATE | 5.7.71 |
| TIME | 16.00 |
| SPECIES | G.d. |
| SEX | ♀ ~~3 yrs.~~ |
| AGE | 3 yrs. |
| COLLECTOR | L. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle. |
| | 2. Liver. |
| OVERALL LENGTH | 14 7/8" |
| TOTAL WEIGHT | 262 gms. |
| LOCATION | Palgarup Town Site |

REMARKS: 3 birds in immediate area 1 taken. Black band on tail 2". white on 2 basterd wing feathers. Tailed black spots on wings. Beak white for 1/2 length

PASTURE/S.F.

| | |
|---|---|
| N° | 36 |
| DATE | 5.7.71 ~~16.35~~ |
| TIME | 16.35 |
| SPECIES | G.d. |
| SEX | ♂ |
| AGE | 2nd Moult. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN 1. | Muscle |
| 2. | Liver |
| OVERALL LENGTH | 15" |
| TOTAL WEIGHT | 280 gms. |
| LOCATION | Pemberton Loam Side |

REMARKS: 7 birds in group Black band on tail 2 1/4". Back barden. No white on bastard wing feather.

PASTURE/G.F.

| | |
|---|---|
| NO° | 37. |
| DATE | 5.7.71 |
| TIME | 16.50 |
| SPECIES | G.d. |
| SEX | ♂ |
| AGE | 4+ yrs. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN 1. | Muscle |
| 2. | Liver |
| OVERALL LENGTH | 16 1/4 |
| TOTAL WEIGHT | 264 gms. |
| LOCATION | 1 ml out of Pemberton on Rothcliffe Rd. |

REMARKS: ~~1 out of Pemberton on Rothcliffe Rd~~ Tail white back. Black band on tail 3/4" wide. white on 2 bastard wing feathers. Black white 3/4 length.

| | |
|---|---|
| N° | 38 |
| DATE | 6.7.71 |
| TIME | 12:50 |
| SPECIES | g.d. |
| SEX | ♂ |
| AGE | 4+ yrs. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle. 2. Liver |
| OVERALL LENGTH | 16 5/8" |
| TOTAL WEIGHT | 338 gms |
| LOCATION | 21 mls from Denmark towards Mt. Barker on main Rd. |

BUSHLAND PASTURE

REMARKS: 6 birds in family 2 taken Large growth on middle toe. Bill white tarsi. Black band 1/8" wide on 2 outstand wing feathers. Beak white 3/4 length.

| | |
|---|---|
| N° | 39. |
| DATE | 6.7.71 |
| TIME | 12:50 |
| SPECIES | g.d. |
| SEX | ♂ by dissn |
| AGE | 2nd Moult. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle 2. Liver |
| OVERALL LENGTH | 16" |
| TOTAL WEIGHT | 305 gms. |
| LOCATION | 21 mls from Denmark towards Mt. Barker on main Rd. |

BUSHLAND PASTURE

REMARKS: Bird very scruffy. (Feather) Leaden Beak. Black band on tail 2". No white on outstand wing feathers.

| | |
|---|---|
| N° | 40. |
| DATE | 6·7·71 |
| TIME | 13·35 hrs. |
| SPECIES | Y.d. |
| SEX | ♂ Hydrid |
| AGE | 2nd Moult |
| COLLECTOR | S. McWhirter. |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN 1. | Muscle |
| 2. | Liver |
| OVERALL LENGTH | 16 1/2" |
| TOTAL WEIGHT | 295 gms. |
| LOCATION | 2 mls. South of Mt Barker on Albany Highway |

PASTURE. BUSHLAND

REMARKS: Beak Leaden. Black band on tail 2". 8 in Family. No white on basters wing feathers. Dark Hair brown spots on white of upper wing

| | |
|---|---|
| N° | 41. |
| DATE | 6·7·71 |
| TIME | 14·15 |
| SPECIES | Y.d. |
| SEX | ♂ |
| AGE | 3rd moult. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN 1. | Muscle. |
| 2. | Liver |
| OVERALL LENGTH | 16 3/4" |
| TOTAL WEIGHT | 320 gms. |
| LOCATION | 6 miles west of Albany on Albany Highway near Austrip. 7/10 mil. north of. |

PASTURE

REMARKS: 8 in Family. Black white for 1/2 length. No white on basterd wing feather. Black band on tail. 1 3/4". other families close by.

| | |
|---|---|
| N° | 42. |
| DATE | 7.7.71 |
| TIME | 11.55 hrs |
| SPECIES | Y.d. |
| SEX | ♂ |
| AGE | 4+ yrs. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN 1. | Muscle |
| 2. | Liver |
| OVERALL LENGTH | 17" |
| TOTAL WEIGHT | 336 gms. |

~~LOCATION~~ Bird alone but there singing in distance

REMARKS. Other bastard wing white on 2 feathers. Beak white for 3/4 long"

LOCATION

~~REMARKS~~: 20 mls from Albany on Bothlom Rd.

PASTURE

| | |
|---|---|
| N° | 43 |
| DATE | 7-7-71 |
| TIME | 1330 hrs |
| SPECIES | C.d. |
| SEX | ♂ |
| AGE | 4+ yrs. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot. |
| SAMPLES TAKEN 1. | Muscle |
| 2. | Liver |
| OVERALL LENGTH | 17 1/4" |
| TOTAL WEIGHT | 303 grms. |

~~LOCATION~~ Remarks: Bird alone. Rest of family feeding about 1/4 mile away. White on 2 of R.W.F. Beak white 3/4 long. Tail white back. Band on tail 1 1/4" black

Location: 1/2 mile along Mt Lemmon - lowlands road from Bothlom - albany Rd.

PASTURE
BUSHLAND

| | |
|---|---|
| N° | 44. |
| DATE | 8. 7. 71 |
| TIME | 10. 30 |
| SPECIES | Y.d. |
| SEX | ♂ |
| AGE | 4+ yrs. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN 1. | Muscle. |
| 2. | Liver |
| OVERALL LENGTH | 17" |
| TOTAL WEIGHT | 305 gms. |
| LOCATION | 11 mls north of Mt. Barker on Albany Highway. |

PASTURE
BUSHLAND

REMARKS: ~~10~~ 2 birds shot others singing in distance white on 2 outer wing feathers. All white back. Black tipped on tail 1". Beak white for 3/4 length.

| | |
|---|---|
| N° | 45. |
| DATE | 8. 7. 71 |
| TIME | 10. 30 |
| SPECIES | Y.d. |
| SEX | ♂ |
| AGE | 4+ yrs. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN 1. | Muscle |
| 2. | Liver |
| OVERALL LENGTH | 17" |
| TOTAL WEIGHT | 315 gms. |
| LOCATION | 11 mls north of Mt. Barker on Albany Highway. |

PASTURE
BUSHLAND

REMARKS: 2 birds shot others singing in distance Black band tail 1¼". White on 2 outer wing feathers. Beak white ¾ length.

PASTURE

| | |
|---|---|
| N° | 46. |
| DATE | 8-7-71 |
| TIME | 1115 |
| SPECIES | g.d. |
| SEX | ♂ 4 ly dess. |
| AGE | 2nd Moult. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN 1. | Muscle |
| 2. | Liver |
| OVERALL LENGTH | 16". |
| TOTAL WEIGHT | 305 gms. |
| LOCATION | ~~11~~ 11·7 mls from Frankland on Cranbrook Frankland Rd. |

REMARKS: NB Some white on 2 Outstd wing feathers. Black spots on white of upper wing. Beak leaden. 2 birds in immediate area. Often dying in distance. Black band on tail. 1 2 3/4

PASTURE

| | |
|---|---|
| N° | 47. |
| DATE | 8·7·71 |
| TIME | 1150 |
| SPECIES | g.d |
| SEX | ♀ 4 ly dess. |
| AGE | 2nd Moult |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN 1. | Muscle |
| 2. | Liver |
| OVERALL LENGTH | 16 1/8 |
| TOTAL WEIGHT | 305 gms |
| LOCATION | 11 mls from Frankland on Rock Gully Rd. |

REMARKS: 6 birds in groups 2 taken Black band on tail 2 1/4 Beak leaden. white on 1 Outstd wing feather

PASTURE.

| | |
|---|---|
| N° | 48. |
| DATE | 8.7.71 |
| TIME | 1150 |
| SPECIES | G.d. |
| SEX | ♂ by dis. |
| AGE | 2nd Moult. |
| COLLECTOR | S. McWhirter. |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN 1. | Muscle |
| 2. | Liver |
| OVERALL LENGTH | 16" |
| TOTAL WEIGHT | 288 gms |
| LOCATION | 11 mls from Frankland on Rocky Gully Rd. |

REMARKS: Black band on tail 2" Beak leader. white on 2 bastard wing feathers.

PASTURE.

| | |
|---|---|
| N° | 49. |
| DATE | 8.7.71 |
| TIME | 1225 |
| SPECIES | G.d. |
| SEX | ♂ |
| AGE | 4+ yrs. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN 1. | Muscle |
| 2. | Liver |
| OVERALL LENGTH | 16 5/8" |
| TOTAL WEIGHT | 300 gms. |
| LOCATION | 3 mls from Frankland on Road to Rivendale. |

REMARKS: 9 in family 1 taken Full white back. white on 2 bastard wing feather. Black band 1". Beak white ½ length

| | |
|---|---|
| N° | 50. |
| DATE | 8·7·71 |
| TIME | 1300 hrs. |
| SPECIES | g.d. |
| SEX | ♂ |
| AGE | 4+ yrs. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN 1. | Muscle |
| 2. | Liver |
| OVERALL LENGTH | 16 1/4" |
| TOTAL WEIGHT | 286 gms. |
| LOCATION | Junction of Cranbrook-Boyup Brook Rd and Jingalup-Riversdale Rd. |

PASTURE.

REMARKS: Bird with one other large mob singing in distance. Black band on tail 1¼". white on 2 bastard wing feathers. Black spot on white of each upper wing.

| | |
|---|---|
| N° | 51. |
| DATE | 8·7·71 |
| TIME | 13 24 |
| SPECIES | g.d. |
| SEX | ♂ |
| AGE | 3rd Moult. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN 1. | Muscle |
| 2. | Liver |
| OVERALL LENGTH | 16" |
| TOTAL WEIGHT | 316 gms. |
| LOCATION:- | 12 mls south west of Jingalup and 3 mls east of Mobrup. |

Swamland. Pasture.

REMARKS: Black band on tail 2" Beak white ½ length. white on 2 bastard wing feathers. Black spot on white of each upper wing.

| | |
|---|---|
| Nº | 52. |
| DATE | 8.7.71 |
| TIME | 1430 |
| SPECIES | y.d. |
| SEX | ♂ dis. |
| AGE | 2nd Moult. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN 1. | Muscle |
| 2. | Liver |
| OVERALL LENGTH | 15" |
| TOTAL WEIGHT | 305 gms. |
| LOCATION | ~~5 mls south of Mundijup on~~ Jingalup Rd. 2 mls west of Jingalup. |

PASTURE.

REMARKS: No white on bastard wing feathers. Black band on tail 2¾" Beak leaden.

| | |
|---|---|
| Nº | 53. |
| DATE | 8.7.71 |
| TIME | 3.15 |
| SPECIES | y.d. |
| SEX | ♂ |
| AGE | 4+ yrs. |
| COLLECTOR | S McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN 1. | Muscle |
| 2. | Liver |
| OVERALL LENGTH | 17¼" |
| TOTAL WEIGHT | 360 gms. |
| LOCATION | 2 mls from Nakenup on the Quelup Rd. |

PASTURE.

REMARKS: Full white back. Black band on tail 1¼". Beak white for ¾. White on 2 bastard wing feathers.

| | |
|---|---|
| N° | 54 |
| DATE | 8-7-71 |
| TIME | 1630 |
| SPECIES | Y.d. |
| SEX | ♂ Lydian. |
| AGE | 2nd Moult |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle |
| | 2. Liver |
| OVERALL LENGTH | 16" |
| TOTAL WEIGHT | 307 gms. |
| LOCATION | 17.3 mls from Bowelling on Dukenellin Rd. |

PASTURE

REMARKS: Black leaden. No white on bastard wing feathers Black band on tail ⅜ 3".

| | |
|---|---|
| N° | 55. |
| DATE | 8-7-71 |
| TIME | 1730 |
| SPECIES | Y.d. |
| SEX | ♂ |
| AGE | 4+ |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle |
| | 2. Liver |
| OVERALL LENGTH | 17" |
| TOTAL WEIGHT | 340 gms. |
| LOCATION | 12.8 mls from Collie. on Dale Rd |

PASTURE

REMARKS: Full white back. White on 2 bastard wing feathers 1". Beak white ¾.

PASTURE.

| | |
|---|---|
| Nº | 56. |
| DATE | 9.7.71 |
| TIME | 0915 |
| SPECIES | g.d. |
| SEX | ♀ by dias |
| AGE | 3rd Moult. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle<br>2. Liver |
| OVERALL LENGTH | 16" |
| TOTAL WEIGHT | 290 gms. |
| LOCATION | 1·2 mls from Bowelling on the main rd to Darkan. |

REMARKS: No white on bastard wing feathers. Beak white for ½ length. Black band on tail ♂ Bird alone.

PASTURE.

| | |
|---|---|
| Nº | 57. |
| DATE | 9.7.71 |
| TIME | 0940 |
| SPECIES | g.d. |
| SEX | ♀ by dias |
| AGE | 3rd Moult |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle.<br>2. Liver |
| OVERALL LENGTH | 16" |
| TOTAL WEIGHT | 300 gms. |
| LOCATION | 11·3 from Bowelling on main Rd to Darkan. |

REMARKS: Black band on tail 2". 6 other birds in group. Beak white for ½ length white on 2 bastard wing feather. 2 black spots on ~~wing~~ white on each upper wing (faded)

PASTURE

| | |
|---|---|
| N° | 58. |
| DATE | 9.7.71 |
| TIME | 1220 ~~1230~~ |
| SPECIES | g.d. |
| SEX | ♂ |
| AGE | 6 yrs |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle |
| | 2. Liver |
| OVERALL LENGTH | 16 1/2" |
| TOTAL WEIGHT | 355 gms. |
| LOCATION | 2.2 mls from Duke on Williams Rd. |

REMARKS: Full white back. white on 2 bastard wing feather. Black band on tail 1 1/2" Beak white yet 3/4. 8 birds in family.

PASTURE

| | |
|---|---|
| N° | 59. |
| DATE | 9.7.71 |
| TIME | 1400 |
| SPECIES | g.d |
| SEX | ♂ |
| AGE | 5+ |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle. |
| | 2. Liver. |
| OVERALL LENGTH | 16 1/4" |
| TOTAL WEIGHT | 310 gms |
| LOCATION | 1.8 mls from William on the Rd to Queensdowning. |

REMARKS: Full white back. white on 2 bastard wing feather. Beak white yet 3/4. Black band on tail

| | |
|---|---|
| N° | 60. |
| DATE | 9.7.71 |
| TIME | 1630 |
| SPECIES | G. d. |
| SEX | ♂ Ly dis — |
| AGE | 2nd Moult. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle |
| | 2. Liver |
| OVERALL LENGTH | 15 1/2" |
| TOTAL WEIGHT | 252 gms. |
| LOCATION | 10.5 mls from William on Rd to Quindanning. |

PASTURE.

REMARKS: Beak Leaden Black Band on tail 2 5/8". White on 1 bastard wing feather

| | |
|---|---|
| N° | 61. |
| DATE | 9.7.71 |
| TIME | 1555 |
| SPECIES | G. d. |
| SEX | ♀ Ly dis. |
| AGE | 3 to 4. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1 Muscle |
| | 2 Liver |
| OVERALL LENGTH | 16 1/8" |
| TOTAL WEIGHT | 315 gms. |
| LOCATION | 1.9 from Quindanning on Rd to Boddington. |

PASTURE.

REMARKS: No white on bastard wing feathers. 2 Black spots on white of each upper wing (Faded) Black white for 3/4 Black band on tail 2".

| | |
|---|---|
| Nº | 62. |
| DATE | 9.7.71 |
| TIME | 16.25 |
| SPECIES | G.d. |
| SEX | ♂ |
| AGE | 3rd Mould |
| COLLECTOR | S. McWhirter. |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle<br>2. Liver |
| OVERALL LENGTH | 16 3/4" |
| TOTAL WEIGHT | 300 gms. |
| LOCATION | 12.6 mls from Quindalup on Rd to Boddington. |

PASTURE / BUSHLAND

REMARKS: White on 2 Bastard wing feathers. Beak white 1/2 length. Black band on tail 1 1/2" Back nearly white. no Black spots on white of the wing.

| | |
|---|---|
| Nº | 63. |
| DATE | 9-7-71 |
| TIME | 1640 |
| SPECIES | G.D. |
| SEX | ♂ |
| AGE | 5+ yrs. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot. |
| SAMPLES TAKEN | 1. Muscle<br>2. Liver |
| OVERALL LENGTH | 16 3/4 |
| TOTAL WEIGHT | 295 gms. |
| LOCATION. | 6.6 mls from Boddington on Rd to Dwellingup |

PASTURE / BUSHLAND

REMARKS. Full white back. Beak white for 3/4 length. Black band on tail 1 1/4". 2 Bastard wing feathers white. 8 in Group 2 taken.

PASTURE.

| | |
|---|---|
| N° | 64. |
| DATE | 9-7-71 |
| TIME | 1655 |
| SPECIES | g.d. |
| SEX | ♂ |
| AGE | 3rd Moult. |
| COLLECTOR | S. McWhester |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle<br>2. Liver |
| OVERALL LENGTH | 16 1/4" |
| TOTAL WEIGHT | 294 gms |
| LOCATION | 6.6 mls from Boddington on Rd to Dwellingup |

REMARKS: 8 in group: 2 Shot. Back lightning white Black band on tail 2". Dark white for 1/2 length. white on 2 bastard wing feathers.

PASTURE.

| | |
|---|---|
| N° | 65. |
| DATE | 10.7.71 |
| TIME | 0810 |
| SPECIES | g.d. |
| SEX | ♀ ♂ Lydia |
| AGE | 3rd Moult. |
| COLLECTOR | S. McWhester |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1 Muscle<br>2. Liver |
| OVERALL LENGTH | 15 3/8". |
| TOTAL WEIGHT | 300 gms. |
| LOCATION | 6.9 mls from Dwellingup on Rd to Pinjarra. |

REMARKS. 6 in Flock. 1 taken Black band on tail 1 5/8". white on 2 bastard wing feathers. Dark black spots on white of each upper wing

| | |
|---|---|
| N° | 66. |
| DATE | 10.7.71 |
| TIME | 1000 |
| SPECIES | Y.d. |
| SEX | ♂ |
| AGE | 2nd Moult. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle<br>2. Liver |
| OVERALL LENGTH | 16 1/4" |
| TOTAL WEIGHT | 295 gms. |
| LOCATION | 5 mls from booby on Rd to Dwellingup. |

BUSHLAND PASTURE

REMARKS: Beak leaden. Black band on tail 2 1/4". No white on bastard wing feathers.

| | |
|---|---|
| N° | 67. |
| DATE | 15.7.71 |
| TIME | 1410 |
| SPECIES | Y.d. |
| SEX | ♂ |
| AGE | 3rd Moult. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle<br>2. Liver |
| OVERALL LENGTH | 16 1/4" |
| TOTAL WEIGHT | 285 gms. |
| LOCATION | Junction of S.W. Highway & Albany Highway 2.6 mls sth. 1.5 mls west on Rd to Fremantle. |

PASTURE. NO EROS.

REMARKS. Black band on tail 1 1/2". 2 faded black spots on white of each upper wing. White on 2 bastard wing feathers. Beak white 1/2 length.

| | |
|---|---|
| N° | 68. |
| DATE | 15.7.71 |
| TIME | 1422 |
| SPECIES | g.d. |
| SEX | ♀ |
| AGE | 3rd Moult. |
| COLLECTOR | D. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle |
| | 2. Liver |
| OVERALL LENGTH | 15¼" |
| TOTAL WEIGHT | 266 gms. |
| LOCATION | 2.6 mls nth of 0.5 Albany Highway and 0.5 mls west on Rd to Lismantle. |

PASTURE NO CROP

REMARKS: Black band on tail 1 7/8". 7 in Family. Several dark black spots on white of each upper wing. White on 1 bastard wing feathe. Beak white ½ length

| | |
|---|---|
| N° | 69. |
| DATE | 15.7.71 |
| TIME | 1445 |
| SPECIES | g.d. |
| SEX | ♂ |
| AGE | 4+ |
| COLLECTOR | D. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle |
| | 2. Liver |
| OVERALL LENGTH | 17" |
| TOTAL WEIGHT | 270 gms. |
| LOCATION | 2.3 mls nth of Byford. |

PASTURE NO CROP

REMARKS. Black band on tail 1¼" white on 2 bastard wing feathe. Full white back. Beak white ¾ length. 3 magpies 2 taken.

| | |
|---|---|
| N° | 70 |
| DATE | 15·7·71 |
| TIME | 1445 |
| SPECIES | y.d. |
| SEX | ♀ by diss. |
| AGE | 3rd Moult. |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle<br>2. Liver |
| OVERALL LENGTH | 16 1/4" |
| TOTAL WEIGHT | 320 gms. |
| LOCATION | 2·3 mls NW of Lyford. |

PASTURE. NO CROP.

REMARKS: Black band on tail 2 3/8". Several black spots on white of each upper wing. Beak white 3/4 length. White on 1 bastard wing feather.

| | |
|---|---|
| N° | 71 |
| DATE | 15·7·71 |
| TIME | 16·00 |
| SPECIES | [redacted] y.d. |
| SEX | ♂ |
| AGE | 4+ |
| COLLECTOR | S. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle<br>2. Liver |
| OVERALL LENGTH | 16 3/4" |
| TOTAL WEIGHT | 303 gms. |
| LOCATION | 1 mi NW of ~~Daylight~~ North Lyford on S.W. Highway |

PASTURE. NO CROP.

REMARKS. Full white back. Beak white 3/4 length. Black band on tail 1 3/4". White on 2 bastard wing feathers.

| | |
|---|---|
| Nº | 72. |
| DATE | 15-7-71 |
| TIME | 16-05 |
| SPECIES | G.d. |
| SEX | ♂ |
| AGE | 3rd Moult |
| COLLECTOR | L. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle<br>2. Liver |
| OVERALL LENGTH | 17 1/8" |
| TOTAL WEIGHT | 305 gms. |
| LOCATION | 1 ml North of North Dandaleyh on S.W. Highway. |

PASTURE
NO CROP.

REMARKS: Beak white for 1/2 length no white on bastard wing feathers. Black spots on white of upper wing. Black band on tail 2 1/2".

| | |
|---|---|
| Nº | 73 |
| DATE | 15-7-71 |
| TIME | 16:30 |
| SPECIES | G.d. |
| SEX | ♂ |
| AGE | 4th Moult |
| COLLECTOR | L. McWhirter |
| HOW COLLECTED | Shot |
| SAMPLES TAKEN | 1. Muscle<br>2. Liver |
| OVERALL LENGTH | 15 1/8" |
| TOTAL WEIGHT | 308 gms. |
| LOCATION | 11 mls east of North Dandaleyh on S.W. Highway. |

PASTURE

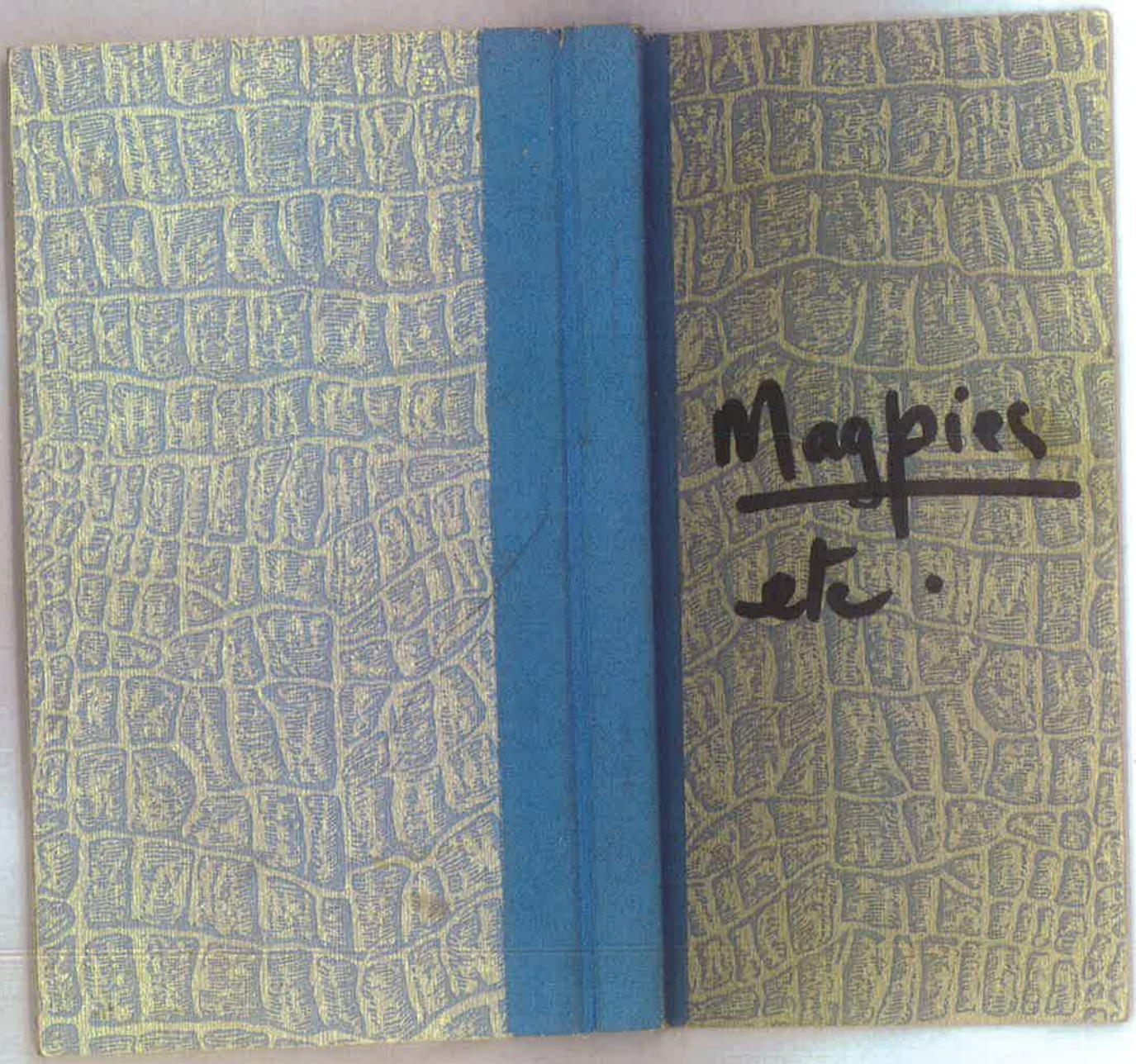
REMARKS. white on 2 bastard wing feather. Back mottled. Black band on tail 1 1/2. Beak white 3/4 length. Sample taken of back feathers. Bird above.

N°
DATE
TIME
SPECIES
SEX
AGE
COLLECTOR
HOW COLLECTED
SAMPLES TAKEN 1.
2.
OVERALL LENGTH
TOTAL WEIGHT
LOCATION

REMARKS:

N°
DATE
TIME
SPECIES
SEX
AGE
COLLECTOR
HOW COLLECTED
SAMPLES TAKEN 1.
2.
OVERALL LENGTH.
TOTAL WEIGHT
LOCATION.

REMARKS.


Magpies
etc.

NUMBER. 74.

DATE 28-8-71 0800 Hours

TIME 0800 hours.

SP. (~~Fantail~~) Crested Pigeon

SEX

AGE

COLLECTOR. S McCwhirter

HOW COLLECTED. Shot

SAMPLES 1. Liver
2 Muscle
3.

LENGTH. 13½"

WT. 205 grms

LOCATION.

NOTES.

Number 75

DATE 28-8-71

Time 0850

SP Magpie

SEX Male ♂

AGE 3rd Moult

COLLECTOR S. McCwhirter

How collected Shot.

Samples 1 liver
2 Muscle

LENGTH 16½"

WT 315 grms

Location

NOTES No white on ~~Sacked~~ wing feather B.B. on tail 2¾" nest on ground flabby r watery.

N° 76
DaTe 28-8-71
Time 0850
SP Magpie
SEX Male
AGE 3rd moult
CoLLecTor S M^c whirTer
How collecTed Shot
samples Liver
Muscle

LEngTh 16"
wT 275 grms
LOCATION

NOTES

NO 77
DATE 28-8-71
TIME 0930
SP Magpie lark
SEX
AGE
Collector S. M^cwhirTer
How collecTed shoT
SAMPLES Liver
Muscle

LENGTh $11\frac{1}{2}$"
WT 100 Gms.
LocaTION

NOTES

78

NO

Date 28-8-71

Time 1050 hour

species Magpie lark

SEX

AGE

Collector S. McWhirter

How collected shot

SAMPLES Liver
Muscle

LEngth 12"

WT 100 gms

Location

NOTES

79

NO

DATE 28-8

TIME 10-50 hours

SP Banded Plover

SEX

AGE

COLLECTOR S. McWhirter.

HOWCOLLECTED SHOT

SAMPLES Liver
Muscle

LEngth 11½"

WT 155 grms

Location

NOTES

NO 80
DATE 28-8-71
time 1120 hours
SP MAGPIE
SEX MAle
AGE 2nd MoulT
Collector S. M Whirter
How collected shot
SAMples Liver
Muscle

LENGth 16½
WT 275 grms
Location

NOTES

NO 81
DATE 28-8-71
TIME 1200 hours
SP BANDed Plover
SEX
AGE
Collector S. M'Whirter
How collected Shot
SAMples Liver
Muscle

Length 11"
WT 155 grms
Location

NOTES

82

NO
DATE 28-8-71
time 1210 hours
SP BANDed Plover
SEX
AGE
collector S. McWhirter
How collected shot
SAMples Liver
Muscles

LENGTh 11½"
WT 170 grms
Location

NOTES

83

NO
DATE 28-8-7
TIME 1220 hours
SP BANded Plover
SEX
AGE
Collector S. McWhirter
How collected shot
SAMples Liver
Muscles

LENGTh 11"
WT 150 grms
Location

84

NO
DATE 28-8-71
TIME 12-30
SP BANded Plover
SEX
AGE
COLLECTOR S. M'WHIRTER
HOW COLLECTED SHOT
SAMPLES Liver
Muscle

LENGTH $11\frac{3}{4}$
WT 195 gms
LOCATION

NOTES

85

NO
DATE
TIME 1330 Hours
SP MARSH LARK
SEX
AGE
COLLECTOR S. M'WHIRTER
HOW COLLECTED SHOT
SAMPLES Liver
Muscle

LENGTH $11\frac{3}{4}$
WT 115 grms
LOCATION

NOTE
Meat on breast is covered
by A layer of Fluby Matterial

NO 86

DATE 28-8-71

time 1800

SP Red Butcher Bird

SEX

AGE

Collector S. M'whirter

How collected shot

SAMples Liver
Muscle

LENGth 13½"

WT 150 grms

Location

NOTES

NO 87

DATE 29-8-71

Time 0830 Hours

SP Banded Plover ✓

SEX

AGE

Collector S. McWhirter

How collected shot

SAMples Liver
Muscle

LENGTH 12"

WT 220 grms

Location

Notes

~~88~~ NO 88

DATE 29-8-71

time 915

SP Ground Lark Brown Dog

SEX

AGE

collector S McWhirter

How collected shot

SAMPLES Liver
Muscle

LENGTH 10"

WT 72 grms

Location

NOTES

NO 89

DATE 29-8-71

time 1000 Hours

SP ~~Ground~~ Lark Brown Dog

SEX

AGE

Collector S. McWhirter

How collected shot

SAMPLES Liver
Muscle

LENGTH 9½"

Location

WT 80 grms

Notes

No 90

DATE 29-8-71

Time 10·40

SP BANDED plover

SEX

AGE - YOUNG, CAP NOT BLACK.

Collector S McWhirter

How collected shot

SAmples liver
Muscle

LENGTH 12"

WT 205 grms

Location

Notes

91

NO

DATE 29·8-71

Time 1130

SP ~~GROUND~~ LARK (Brown Song)

SEX

AGE

Collector S. McWhirter

How collected shot

SAmples Liver
Muscle

LEngths 10"

WT 85 grms

LocaTion

NO 92
DATE 29-8-71
TIME 1200
SP Brownsay Lark
SEX
AGE
Collector S. M'Whirter
How collected shot
SAMPLES Liver
Muscle

Length 10"
WT 80 grms
Location

Notes

1-9-71 93

No. 93
Date 1-9-71
Time 11.20 HRS.
Sp. Brown long tark.
Sex ♂
Age
Collector R. PRINCE
How Coll. SHOT.
Samples taken 1. LIVER
4 GUT CONT 2. MUSCLE
3 brain
Length 9½"
Weight 70 gms.
Location:-

Not sprayed

Notes:- Eyes brown.
Legs black
Bird healthy Many have flopper about. Sprayed 1.9.71 a.m
Active ingt. 4 ozs/acre.

N° 94

Date 1-9-71

time 11.50 HRS

Sp. Pipit

Sex ♂

age

Collector R. PRINCE

How Collected SHOT

Samples 1. LIVER

4. GUT CONT 2. MUSCLE

3. BRAIN

Length :- 7"

Weight 30 gms.

Location

Not Sprayed "

Sprayed 1-9-71 a.m.

Notes :-

Club right foot insects + harbour in crop

Pupils brown

Spots flesh - white head healthy -

N° 95

Date 1-9-71

time 12.30

Sp. Banded Plover

Sex ♂

age

Collector R.P.

How Coll. SHOT.

Samples 1 liver

4 GUT CONT. 2. Muscle

3. Brain.

Length :- 11"

Weight 210 gms.

Location

NOT

Sprayed ~~1-9-71 a.m.~~

Notes.

legs purple. red

Iris yellow

Beak. pale - white

Testicles small.

not many

harbour in gut.

Bird Healthy.

| | |
|---|---|
| N° | 96 |
| Date | 1-9-71 |
| time | 1720 hrs. |
| sp. | Banded Plover |
| sex | ♀ |
| age | |
| Collector | Smc |
| How Coll. | SHOT |
| Samples | 1. liver |
| + gut content | 2. Muscle |
| | 3 Brain |
| Length | 11½" |
| Weight | 210 gm |
| Location | |

Notes.
legs purple to black.
Iris yellow. Gape pale.
Sprayed 1-9-71 a.m.
Bird Healthy.

| | |
|---|---|
| N° | 97 |
| Date | 1-9-71 |
| time | 1720 |
| sp. | Banded Plover |
| sex | ♂ |
| age | adult. |
| Coll. | Smc Waitoa. |
| How Coll. | SHOT. |
| Samples | 1 liver |
| | 2 muscle |
| | 3 Brain |
| | 4 Gut Cont. |
| Length | 11½ |
| Weight | 200 gm |
| Loc. | |

Notes: Sprayed 1-9-71 a.m.
Pinkish - black legs.
iris yellow
Gape pale

98

No
Date 2-9-71
Time 0950
Sp. Brown long tail
Sex ♂
age
Collector S. M. Uhlenbeck
How Coll SHOT.
Sample 1 Muscle
2 Liver
3 Brain
4 Gut Contents
Length 10"
Weight 80 gm
Locality

Scaly chest.
Notes:- Edge of tray of 1-9-71 P.M. and 1-9-71 a.m.
Gape black, legs flesh-coloured. Eyes brown.

99

No
Date 2-9-71
Time 1045
Sp. Brown long tail
Sex ♂
age
Collector S. M. Uhlenbeck
How Coll SHOT.
Sample 1 Muscle
2 Liver
3 Brain
4 Gut contents
Length 9½"
Weight 85 gms.
Locality

Bird had centipedes for breakfast. *
Notes Sprayed a.m. of 2-9-71
Gape black
Eyes brown
Legs flesh-coloured

No 100

Date 2-9-71

Time 1200.

Sp. Brown long fork

Sex ♂

Age

Collector S. McWhirter.

How Coll. SHOT.

Samples 1. Muscle
2. Liver
3. Brain
4. Gut Contents

Length 9½"

Weight 85 gm.

Loc.

Notes. legs greyish.
eyes - brown
gape - black
Sprayed 1-9-71 am.

No 101

DATE 2-9-71

TIME 1235 p

SP. Brown long fork

SEX ♂

AGE

COLLECTOR S. MCWHIRTER

HOW COLL. SHOT.

SAMPLES 1 MUSCLE
2 LIVER
3 BRAIN
4 GIZZARD CONT.

LENGTH 9½"

WEIGHT 75 gm.

LOC.

Sprayed 1-9-71 a.m.

NOTES.
legs pale
yoke black.
eyes brown.
caterpillars in gizzard.

N° 102

DATE 2-9-71

TIME 1300 hr

SP. Brown long bill.

SEX ♂.

AGE

COLLECTOR S.M^c.

HOW COLL. SHOT.

SAMPLES 1. MUSCLE.
2. LIVER
3. BRAIN
4. GIZZARD CONT.

LENGTH 8 3/4"

WEIGHT. 60gm

LOC.

NOTES. Sprayed 31-9-71
legs pale-brown a.m.
iris ~~yellow~~ brown
gape black.

N° 103

DATE 2-9-71

TIME 1325

SP. Brown Song bird

SEX ♂

AGE

COLLECTOR. S M^cWHIRTER

HOW COLL. SHOT

SAMPLES 1 MUSCLE
2. LIVER
3. BRAIN.
4. GIZZARD CONT.

LENGTH 9 3/4"

WEIGHT 85gm

LOC.

NOTES. Iris Brown
legs pale. Gape black.
Sprayed a.m. 31-9-71

| | |
|---|---|
| NO | 104 |
| DATE | 2-9-71 |
| TIME | 1345 |
| SP. | Brown Sooty Tern |
| SEX | ♂ |
| AGE | |
| COLLECTOR | SMITHWICK |
| HOW COLL. | SHOT |
| SAMPLES | 1. MUSCLE |
| | 2. LIVER |
| | 3. BRAIN |
| | 4. GIZZ. CONT. |
| LENGTH | 9½" |
| WEIGHT | 80 gm. |
| LOC. | |

NOTES. Legs pale
Eye brown
beak black
Sprayed 31-9-71 a.m.

| | |
|---|---|
| NO | 105 |
| DATE | 2-9-71 |
| TIME | 1400 |
| SP. | Brown Sooty Tern |
| SEX | ♂ |
| AGE | |
| COLLECTOR | SMITHWICK |
| HOW COLL. | SHOT |
| SAMPLES | 1. MUSCLE |
| | 2. LIVER |
| | 3. BRAIN |
| | 4. GIZZ. CONT. |
| LENGTH | 9½" |
| WEIGHT | 80 gm. |
| LOC. | |

NOTES. Legs pale
Eyes brown
Beak black
Sprayed 31-9-71 a.m.

| | |
|---|---|
| N° | 2-9-71 106 |
| DATE | |
| TIME | 1445 ? |
| SP. | Brown Sooty Tern |
| SEX | ♂ |
| AGE | |
| COLLECTOR | S Hewitt |
| HOW COLL. | SHOT |
| SAMPLES | 1 MUSCLE |
| | 2 LIVER |
| | 3 BRAIN |
| | 4 GIZZARD CONT. |
| LENGTH | 9½" |
| WEIGHT | 70 gm. |
| LOCATION | |

NOTES.
legs pale
Eyes brown
gape black
Sprayed 31-8-71

| | |
|---|---|
| N° | 107 |
| Date | 2-9-71 |
| time | 1700 Hrs |
| Sp. | MUDLARK. (REDWITT) |
| Sex | ♂ |
| age | |
| Collector | S. HEWITSON |
| How Coll | SHOT |
| Samples | 1 Muscle |
| | 2 Liver |
| | 3 Brain |
| | 4 Eggs. Cont. |
| Length | 11½" |
| Weight | 110 gm |
| Loc. | |

Notes. Iris pale yellow
beak + gape white
legs black.
Sprayed 1-9-71

No. 108
Date 2-9-71
Time 1710 hrs
Sp. MOOLARK.
Sex ? ♀ young.
age
Collector S. MEREDITH
How Coll. SHOT.
Samples 1 Muscle
2 Liver
3 Brain
4 ♀ Egg Cont.
Length 11"
Weight 90gms
Location

Notes Purple pink.
Beak cream. Brown tip
Leg black.
Sprayed 1-9-71 ass'n

No 109
Date 2-9-71
Time 1750
Sp Banded Plover.
Sex ♀ GIRL!
Age
Collector S. Meredith
How Coll SHOT.
Samples 1 Muscle
2 Liver
3 Brain
4 Egg Cont.
Length 11"
Weight 195 gms.
Location

Notes. grape grey
legs purplish
Eye yellow.
Sprayed 31-8-71

PASTURE 110

N° 110
DATE 16·2·72
TIME 1425
SP. G.d.
SEX ♀ (?)
AGE 3RD MOULT.
COLLECTOR S. McWHIRTER
HOW COLL. SHOT.
SAMPLES 1 LEGS.
2
3
4

*#136

LENGTH 14¾"
WEIGHT 262 gms.
LOCATION ½ mile south of turnoff to Serpentine Dam on S.W. HIGHWAY.

| | DDT+ | Dieldrin |
|---|---|---|
| M | 0·05 | 0·004 |
| L | 0·01 | 0·008 |

NOTES. Black band 1½" on tail. little white on barbs of wing feathers (MOULTING)

N° 111
DATE 16·2·72
TIME 1830
SP. G.d.
SEX ♀ ♂.
AGE 1ST MOULT.
COLLECTOR S. McWhirter
HOW COLL. SHOT.
SAMPLES 1
2

LENGTH 16"
WEIGHT 295 gms.
LOCATION KARRAGULLEN
1 mile North on Rd to Pickering Brook.

*#130

NOTES. Black band 2" on tail.

| | DDT+ | Dieldrin |
|---|---|---|
| M | 0·8 | 0·3 |
| L | 3·6 | 1·8 |

BUSH & ORCHARD

N° 112

DATE 16.2.72

TIME 1630

SP. Cd

SEX ♂

AGE 2nd Juvenile

COLLECTOR S.M.E

HOW COLL. SHOT

SAMPLES 1

2

3

4

LENGTH 16½"

WEIGHT 305 gm.

LOCATION 1 mile north of Harrowsmith on Rd to Pickering Brook *#135

| | DDT+ | Dield |
|---|---|---|
| M | 3·8 | 0·6 |
| L | 6·8 | 1·1 |

NOTES Black band ½" wide on tail.

BUSH & ORCHARD.

N° 113

DATE 16.2.72

TIME 1900

SP. G.d

SEX ♂?

AGE 9+ yr.

COLLECTOR S.M.E.

HOW COLL. Shot

SAMPLES 1

2

3

4

LENGTH 17"

WEIGHT 332 gm

LOCATION PICKERING BROOK TOWNSITE. *#137

| | DDT+ | Dield |
|---|---|---|
| M | 3·8 | 0·4 |
| L | 9.8 | 0·4 |

NOTES. Black 1½" on tail.

BUSH & ORCHARD

N° MF

date 16.2.72

time 1905

Sp. G.d.

Sex ♀

Age 2ND month

Collector D. Mellor

How Coll SHOT.

Samples 1

2

3

4

Length 15½.

Weight 290 gms.

Location one mile West of Pickering Road on Road to Kabanana.

| | DDT | Field |
|---|---|---|
| M | 0.2 | 0.03 |
| L | 0.2 | 0.06 |

*#127

BUSH & ORCHARD 7/5

N° 27

DATE 20.2.72

TIME 1735

SP. G.d.

SEX ♀

AGE 3RD MOULT

COLLECTOR [illegible]

HOW COLL. SHOT

SAMPLES 1

2

3

4

LENGTH 15½.

WEIGHT. 295 gms

loc Hackett Gully. (NEAR VIN'S)

| | DDT | Field |
|---|---|---|
| M | 9.0 | 0.01 |
| L | 25.0 | 0.18 |

*#124

BUSH & ORCHARD

N° 116

DATE 20·2·72

TIME 1735.

SP. Gd.

SEX ♂.

AGE 2ND moult.

COLLECTOR SM"

HOW COLL. SWEEP

SAMPLES 1

2

3

4

LENGTH 16"

WEIGHT 265gm.

LOCATION Hackett, Gully (VIN's flat)

*#131

| | DOT+ | Dield |
|---|---|---|
| M | 1·2 | 0·02 |
| L | 1·7 | 0·1 |

BUSH & ORCHARD

N° 117

DATE 20·2·72

TIME 1835.

SP. Gd.

SEX ♂

AGE 1ST moult

COLLECTOR SM"

HOW COLL. SWEEP

SAMPLES 1

2

3

4

LENGTH 17"

WEIGHT 295

LOC Mundaring Weir Reserve

*#132

| | DOT+ | Dield |
|---|---|---|
| M | 0·3 | 0·02 |
| L | 0·5 | 0·1 |

BUSH × ORCHARD

N° 118

DATE 20 2 72

TIME 17.5

SPECIES Gd.

SEX ♂

AGE 4+ yrs (5-6)

COLL. Sen

HOU COLL. SHOT.

SAMPLES 1

2

3

4

LENGTH 16 3/4"

WEIGHT 335 gm

DDT + Dield

LOCATION. M 14. 0.1

L 8.2 0.05

1 mile W. Rushing Brook Toronto.

White on 2 of Barstail Wing feathers 1/4 black on tail

Proc Start By RH.

119

DATE 11-2-71

TIME:

SPECIES G ♂

SEX ♂

AGE

COLLER

HOU COLL

SAMPLES 1

2

3

4

LENGTH 16½" 42cm

WEIGHT 29.35 gms

LOCATION

6.7 miles to Heron Pk on Rt Rd

| | DDT + Metabolite | Dieldrin |
|---|---|---|
| Muscle | 0.04 ppm | 0.002 |
| L. | 0.02 | 0.02 |

120

DATE 8.2.71
TIME 1500 hrs
SPECIES GD
SEX ♂ ? too young
AGE 1" antl. or 2
COLL Glacier JAKL
HOW shot
SAMPLES
1. M
2. L

Length 15 1/8"
Weight 250 gms

10 mls on Greenland *
Cleared cattle grazing country.

| | DDT+ | Dield |
|---|---|---|
| Muscle | 0.004 | 0.002 |
| L | 0.008 | 0.01 |

121

DATE 9.2.71
TIME
SPECIES Gd
SEX ♂ adult
AGE adult 3+
COLL ♀ JAKL
HOW Shot
SAMPLES 1. L
2 M.

Weight 32.31 gms
16 1/4" 41.3 mm

Cleared grazing country

| | DDT+ | Dield |
|---|---|---|
| Muscle | 0.004 | 0.002 |
| L | 0.008 | 0.01 |

122

Date 2.4.73
Time
Species G.d
Sex ♂
Age Full adult.
Coll'er Noble
How Shot?
Samples 1.
2.

1973

Length 16¾ 42.5cm
Weight 29.23

Noble FW
Hastings St Scarb.

| | DDT+ | Dield |
|---|---|---|
| Muscle | 0.02 | 0.002 |
| L | 0.02 | 0.01 |

123

Date 26.10.72
time ?
Species Gd
Sex ♂
age Full whole Back: Adult.
Coll'er M. Osbourne FW
How Shot
Samples 1.
2.

Length 41 cm
Weight 31.66 gms

| | DDT+ | Dield |
|---|---|---|
| Muscle | 0.4 | 0.3 |
| L | 2.0 | 1.7 |

Date
Time
Species G d
Sex 3RD moult ♀
Age " "
Coll'd ?
How ?
Sample 1 L
2 M

Lngth 15⅝" 39cm.
Weight 2556 gm

Has a N°ed tag 115

| | DDT + | Diald |
|---|---|---|
| Muscle | 9.0 | 0.01 |
| L | 25. | 0.18 |



Date 17.11.72
Time ?
Spec G d
Sex ♀ ♂
Age 3RD Moult
Coll'd ?
How ?
Sample 1 L
2 M

Lngth 31.49 gm
Weight 40 a 15 3/4

| | DDT | Dieldrin |
|---|---|---|
| Muscle | 0.4 | 0.5 |
| L | 3.4 | 3.4 |

~~126~~

Date 10.12.71
Time
Species Gd
Sex
Age
Collected R P Donnelly
How ? Died ?? O
Sample 1. L
2. M

Weight
Length

Code Z
Already Sampled

~~127~~ 126

Date 23.10.72
Time
Species Gd.
Sex ♂
Age Adult
Collector
How
Sample 1
2

Weight 31 gms
Length 16 3/4 43cm

Eric St Cornu

| | DDT+ | Dield |
|---|---|---|
| Muscle | 0.9 | 0.2 |
| L | 3.2 | 1.0 |

127

Date
Time
Spec
Sex ♂
Age 2ND Moult
Collector:
How:
Sample 1 L
2 M

Length 39 cm 15½
Weight 24.79 gms

№ 114

| | DDT+ | Dield |
|---|---|---|
| M | 0.2 | 0.03 |
| L | 0.2 | 0.06 |

128

Date 20.11.72
Time
Species Gd
Sex ♂
Age 2ND Moult.
Collected M. Osborne
How Shot.
Sample 1 L
2 M

Length 37 cm 14½"
Weight 25.11 gms

Trunk St
Cloverdale

| | DDT+ | Dield |
|---|---|---|
| M | 0.4 | 0.4 |
| L | 1.7 | 1.7 |

Date 23-10-72
Time
Spec's
Sex ♂
Age Adult
Collector ?
How ?
Sample 1 L
2 M

Length 40 cm 15¾"
Wt 29 gms

Beth Rd Morley

| | Dot + | Dried |
|---|---|---|
| M | 0·4 | 0·2 |
| L | 1·2 | 1·5 |



Date
Time
Spec's
Sex ♂
Age 1st Moult
Collected
How
Sample 1 L
2 M

Length 15½" 40cm
Wt 25 gms

No 111

| | Dot + | Dried |
|---|---|---|
| M | 0·8 | 0·3 |
| L | 3·6 | 1·8 |

Date
Time
Species Gd
Sex ♂
Age 2nd Moult
Collector?
How?
Sample 1 L
2 M

Wt 23.46
Length 16½" 40cm

№ 116

| | DDT+ | Dield |
|---|---|---|
| M | 1.2 | 0.02 |
| L | 1.7 | 0.1 |



Date
Time
Species
Sex ♂
Age 2nd Moult
Collector
How
Sample 1 L
2 M

Wt 25.84
Length 43.5cm 17⅛"

№ 117

| | DDT+ | Dield |
|---|---|---|
| M | 0.3 | 0.008 |
| L | 0.5 | 0.1 |

133

Date
Time
Species Gd
Sex ♂
Age Full white Beak about 1
Collector
How
Sample 1 L
2 M

Length 17" 43·2
Weight 29·73 gms

N°118

| | DDT+ | Dield |
|---|---|---|
| M | 14·0 | 0·1 |
| L | 8·2 | 0·05 |

134

Date 20·10·72
Age
Spec Gd
Sex ?
Age 1st Moult ??
Collector M Osborne
How
Sample E
Muscle only
NO River left of tail shot.

Length 17½" 44·0 cm
Wt 33·51 gms

52 Sanderson St Como

| | DDT+ | Dield |
|---|---|---|
| M* | 4·2 | 3·2 |
| L | — | — N.S. |

Liver shot up NA

135

Date
Time
Spec Gd
Sex ♂ ?
Age 2nd Moult
Collected
How
Sample 1
2

Length 16¼ 41.5 cm
Weight 26.8 grams

Was 112

| | DDT+ | Dield |
|---|---|---|
| M | 3.8 | 0.6 |
| L | 6.8 | 1.1 |

136

Date
Time
Species
Sex ♂
Age 3rd Moult
Collected
How
Sample 1 L
2 M

Length 15⅛ 38.5 cm
Weight 23.0 grams

Was 110

| | DDT+ | Dield |
|---|---|---|
| M | 0.05 | 0.004 |
| L | 0.01 | 0.008 |

137

Date
Time
Species Gd
Sex ♂
Age Full white
Collector
How
Sample / L
2 M

Length 16¼ 42.5 cm
Weight 30.84 gms

Was 113

| | DOT+ | Dield |
|---|---|---|
| M | 3.8 | e.4 |
| L | 9.8 | 0.4 |

138

Date 13-10-72
Time
Species Grey Butcher bird
Sex ♂
Age Adult moulting
Collector
How
Sample / L
2 M

♂ Grey Butcher Bird

Length 12" 30.5 cm
Weight 8.86 gms

Kent St, Willoughby

| | DOT+ | Dield |
|---|---|---|
| M | 1.8 | 1.6 |
| L | 3.2 | 3.2 |

139

Date :
Time
Species Gd
Sex ♂
Age adult.
Collector :
How :
Sample 1
2 ??

Length 42 cm 16½"
Weight 31.9g

? Was No 1 ? of what set

| | DDT | Dield |
|---|---|---|
| M | 0.01 | 0.005 |
| L | 0.02 | 0.007 |

of ??

140

Date
Time
Species Gd
Sex
Age 3rd Moult.
Collector
How
Sample 1
2

Length 41.5 cm
Wt #319 ~~23.8~~ 23.8g query
Was in bag with butcher bird 138 [illegible] W0's 7
Unknown - NO tag

| | DDT | Dield |
|---|---|---|
| M | 2.3 | 1.1 |
| L | 3.3 | 12 |

of anyone

141 #143

Date 13.10.72

Time

Species

Sex ♂ ??

Age adult 4th

Collector

How

Sample 1
2

Length 16 40.7cm

Weight 31.39 gms

Vivereash
(Middle Sevan)
Stewartlyches

| | DOT+ | Dried |
|---|---|---|
| M | 0.4 | 0.1 |
| L | 1.7 | 0.2 |

142

Date 13.10.72

Time

Species Gd

Sex ♂

Age adult.

Collector

How

Sample 1
2

Length 38-0 15"

Weight 30.23 gms

| | DOT+ | Dried |
|---|---|---|
| M | 0.3 | 0.2 |
| L | 0.5 | 0.5 |

143 *141

Date 13.10.72

Time

Species

Sex ♂ ?

Age 2nd Moult.

Collected

How

Sample 1 L
2 m

| | DDT + | Field |
|---|---|---|
| M | 0.3 | 0.03 |
| L | 1.7 | 0.2 |

Length 15½" 39.5 cm

Weight 30.09

" Nuweah "

Middle Swan

Stewart by Cree

144

Date 16.10.72

Time

Spec G.d.

Sex ♂

Age Adult.

Collector ?

How Shot

Sample 1 L
2 m

| | DDT + | Field |
|---|---|---|
| M | 1.2 | 0.3 |
| L | 3.8 | 2.2 |

Weight 29.59

Length 39.0 cm 15¼"

57 North Beach Rd
Nth Beach

145

Date 11.10.72
time
Species Gd
Sex ♂
age adult
Collector F.W
How
Sample

| | DDT+ | Dield |
|---|---|---|
| M | 0.4 | 0.1 |
| L | 0.6 | 0.2 |

Length 16 3/8" 42 cm
Weight 33.20

Walton Rd Moreley
near Russel St.
1

146.

#-150

Date 16.10.72
time
Species
Sex ♂
age adult.
Collector
How
Sample 1 L
2 M.

| | DDT+ | Dield |
|---|---|---|
| M | 0.4 | 0.1 |
| L | 0.5 | 0.3 |

Length 43.5 cm
Weight 29.56.

Rochester Circle
Balga

1149

DATE 17/10/72.

TIME 2 PM.

SPECIES Gd.

SEX ♂

AGE ADULT.

COLLECTOR P. PENNINGS

HOW SHOT

L & M.

LENGTH 16½".

WEIGHT 310 gm (11oz).

29 TRESSIDER RD.

LOCKRIDGE.

* 146

1150

DATE 16/10/72.

TIME.

SPECIES Gd.

SEX ♀

AGE ADULT.

COLLECTOR.

HOW SHOT.

L & M.

LENGTH 15½"

WEIGHT 305 gm (10.75oz)

ROCHESTER CIRCLE

BALGA.

151

DATE 13/10/72.

TIME

SPECIES Gd.

SEX

AGE

COLLECTOR

HOW SHOT.

L & M.

LENGTH 14".

WEIGHT 255gm (9oz).

Forrestfield
York Rd.

152 *153

DATE 14/2/72

TIME

SPECIES Gd.

SEX ♂

AGE ADULT

COLLECTOR H. HALL.

HOW. SUDDEN DEATH AFTER EATING DEAD DUCK ENTRAILS PRESUMED TO BE THE CAUSE.

L & M.

LENGTH 13½"

WEIGHT 304gm (10.75oz)

153. *152

DATE 14/2/72.

TIME —

SPECIES G.d.

SEX ♂

AGE 3rd Month.

COLLECTOR. A. HALL.

HOW SEE 152

L + M.

LENGTH 13½"

WEIGHT - 270gm (4·5g).

Mappei

Pete Rumsey
mid '87
drawings

TAKE work, fish
etc

ad hoc.

acute

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cont

Ken ? in VSC Apse

Pleiades

Land Groups, Boss off

D R A F T

ROBERT I.T. PRINCE

# PESTICIDE RESIDUES IN WESTERN AUSTRALIAN WILDLIFE

## 1. Organochlorine residues in the Western Magpie (Gymnorhina dorsalis) in the south west.

### Introduction

The organochlorine or chlorinated hydrocarbon insecticides, of which DDT is perhaps the best known, have in the recent past been of great benefit to public health authorities and to agricultural industries throughout the world because of their ability to kill a wide range of insect pests, their commonly low acute toxicity to mammals, and the ease with which they could be extensively distributed and applied (refs ). Increasing tolerance acquired by many of the target insect pests with the passage time reduced the initial effectiveness of DDT as an insecticide, leading firstly to the need for increased rates of application to achieve the same levels of control and eventually to replacement of, or substitution for DDT in many cases with a new suite of synthetic insecticides, including additional members of the family of chlorinated hydrocarbons e.g. dieldrin, aldrin, endrin, etc., and the often more toxic organophosphates (refs ).

Following the early euphoric publicity of the direct benefits occurring from the use of DDT it became clear that contamination of foodstuffs was still a potential public hazard. It also soon became clear that DDT and its chemical relatives posed chronic hazards to wildlife and had the capacity to permeate food chains far removed from the site of application (refs ). One of the better known side effects attributable to penetration of food chains by DDT and related chemicals is the phenomenon of egg-shell thinning affecting populations of top order avian predators

such as the Osprey (Pandion haliaetus) and Peregrine Falcon (Falco peregrinus) (refs ).

DDT, dieldrin, and other chlorinated hydrocarbon insecticides were being used in Western Australia during the early 1970s (e.g. refs ) but no specific data on either the quantities being used or the pattern of distribution of use within the state could be obtained. There were also no data on the probable accumulation of residues of these insecticides in any indigenous wildlife species. A pilot study to assess the general penetration of residues into local food chains and the presumed affects of differing levels of use of DDT and dieldrin in particular was commenced in south western Western Australia in December 1970.

## Materials and Methods

### Study Area

The study was focussed on the south western corner of the state where the majority of the human population lives and where the longest history of continued insecticide usage for protection of household gardens, horticultural crops, irrigated pastures and dryland cereal crops could be expected. The majority of the collecting required was concentrated within the area bounded by the west coast and a line from Perth to Albany (Fig. 1.). The region generally experiences a pronounced Mediterranean climate with hot dry summers and cool wet winters (ref ). Annual rainfall varies from as much as 1400 mm per annum on parts of the south coast, and in a small area on the western edge of the Darling Scarp to the south east of Perth, to as little as 400 mm per annum in the dryland farming areas at the eastern inland boundary of the study area. _____ percent of the annual average rainfall is received between the months of _____ and _____ (ref ). The major growing period for annual crops and pastures is _____ (ref ).

Sampling

The Western Magpie (Gymnorhina dorsalis) was selected as the indicator species for assessing contamination of the terrestrial environment because this relatively large (length, weight) passerine is widespread and numerous throughout the south west, predominantly insectivorous, long-lived (to 9 years in the field), sedentary and territorial (family groups holding territories of c. 10-100 ha.), and can readily be aged (refs ). These birds can also be easily kept in captivity.

Birds required were selected from among their family groups and shot using a .410 shotgun [with no. 4 shot?]. Relevant collection details were usually recorded in the field. Fresh tissue samples were taken by opening the carcase along the ventral mid-line. Pectoral muscles were then separated from the body and placed in labelled containers supplied by the Western Australian Government Chemical Laboratories.

Livers were also dissected out and treated similarly. The separate containers with these individual liver and muscle samples were then frozen by contact with dry ice and maintained in this way for transport back to the laboratory. This was the preferred method of sampling. Frozen samples as collected were held in a deep freeze prior to processing for residue analyses.

Where field processing was not possible the collectors were instructed to freeze the birds taken as soon as possible after death, and to then arrange for the still frozen birds to be forwarded to the Wildlife Research Centre. Birds collected in this manner were held in deep freeze until sampling. At this point the carcases were thawed to facilitate dissection and pectoral muscle and liver samples taken as described previously for fresh shot birds. These tissue samples were also refrozen for holding prior to residue analysis.

Liver and pectoral muscle were the only tissues of sufficient mass to permit individual analyses. Other tissues were generally not sampled because of this restriction.

Analyses

Glass containers used for collection and storage of tissue samples were pre-washed with to prevent contamination of samples. Tissue samples for analyses were thawed extracted etc. Analysis using according to the method of (refs. Geoff Ebell).

Results

One hundred and fourteen Western Magpies (Gymnorhina dorsalis) were collected between December 1970 and mid-April 1973 when the collecting programme was terminated. The majority (70) of these birds were collected and field sampled within the Perth-Albany-Cape Naturaliste triangle (lower south west) during June-July 1971. The additional 44 birds were obtained from a number of other sources as detailed below.

One of the 19 birds obtained for sampling from within the urban section of the Perth Metropolitan Area was collected in December 1971 by an amateur gardener who had seen the bird collapse and then die and was worried that insecticides and nematocides he had used may have been implicated in the bird's death. The other 18 were aggressive birds shot by state Fauna Wardens (now Wildlife Officers) in order to protect the public from injury. All but one of these was taken during October-November 1972. The remaining bird was taken in April 1973.

A further 8 birds were taken in the Pinjarra-Mandurah district during the period December 1970 through February 1971, and another six from the areas north of Perth, three from different sites in December 1970 and another three from

the Mingenew district in August 1971. The mixed orchard and forest area in the hills to the east of Perth provided 8 more birds in February 1972. The remaining three birds included two shot by Fauna Wardens, and one other taken by wildlife research staff. Due to oversight, samples from four of the birds from the Perth urban area were not passed on for analysis. Data for the 110 birds submitted for residue analyses are summarized in Table 1.

TABLE 1

North of Perth

| Bird Sample No | Date Collected | Collecting Locality | Sex | Age Class | Body Weight | Length | Habitat type | Liver DDT & metabs | Liver Dieldrin | Muscle DDT | Muscle Dieldrin |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 75 | 8/71 | Mingenew | ♂ | 2+ | 315g | 42.0cm | Farmland | 0.01+ | 0.01 | a | a |
| 76 | 8/71 | Mingenew | ♂ | 2+ | 275g | 40.5cm | Farmland | 0.03 | 0.01 | 0.01+ | a |
| 80 | 8/71 | Mingenew | ♂ | 1+ | 275g | 42.0cm | Farmland | 0.02+ | 0.02 | a | a |
| ? | 12/70 | Marchagee | ? | ? | ? | ? | Farmland | 0.02+ | <0.01 | 0.01 | <0.01 |
| ? | 12/70 | Watheroo | ? | ? | ? | ? | Farmland | No sample | | 0.03 | 0.02 |
| ? | 12/70 | Guilderton | ? | ? | ? | ? | Farmland | 0.02 | 0.43 | 0.01+ | 0.11 |

Perth urban area

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Donnelly Bird 123 | 12/71 | Claremont | ? | ? | ? | ? | Home Garden | 12.0 | 19.0 | 9.6 | 13.0 |
| | 10/72 | Metro area | ♂ | Adult (Whiteback) | [355g] | 41.0cm | Urban | 2.0 | 1.7 | 0.4 | 0.3 |
| 126 | 10/72 | Como | ♂ | Adult [4+] | [350g] | 43.0cm | Urban | 3.2 | 1.0 | 0.9 | 0.2 |
| 129 | 10/72 | Morley | ♂ | Adult [4+] | [325g] | 40.0cm | Urban ?[fringe] | 1.2 | 1.5 | 0.4 | 0.2 |
| 134 | 10/72 | Como (Prob ♀, RP) | ?? | ?1+ | [375g] | 44.0cm | Urban | No sample | | [4.2 | 3.2] |
| 140 | 10/72 | Willetton? | ? | 2+ | [245g] | 41.5cm | Urban | ?33.0 | 12.0 | 2.3 | 1.1 |
| 141 | 10/72 | Viveash | ♂ | Adult [3+] | [355g] | 40.7cm | Urban fringe | 1.7 | 0.2 | 0.4 | 0.1 |
| 143 | 10/72 | Viveash | ♂ | 1+ | [340g] | 39.5cm | Urban fringe | 1.7 | 0.2 | 0.3 | 0.03 |
| 142 | 10/72 | Metro area | ♂ | Adult | [340g] | 38.0cm | ?Urban fringe | 0.5 | 0.5 | 0.3 | 0.2 |
| 144 | 10/72 | North Beach | ♂ | Adult | [330g] | 39.0cm | Urban | 3.8 | 2.2 | 1.2 | 0.3 |
| 145 | 10/72 | Morley | ♂ | Adult | [375g] | 42.0cm | Urban fringe | 0.6 | 0.2 | 0.4 | 0.1 |
| 146 | 10/72 | Balga | ♂ | Adult | [335g] | 43.5cm | Urban fringe | 0.5 | 0.3 | 0.4 | 0.1 |
| 125 | 11/72 | Metro area | ♀ | 2+ | [355g] | 40.0cm | Urban | 3.4 | 3.4 | 0.4 | 0.5 |
| 128 | 11/72 | Cloverdale | ♂ | 1+ | [285g] | 37.0cm | Urban | 1.7 | 1.7 | 0.4 | 0.4 |

| | | | | | | | | Liver | | Muscle | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 122 | 4/73 | Scarborough | ♂ | Adult | [325g] | 42.5cm | Urban (fringe) | 0.02 | 0.01 | 0.02 | <<0.01 |
| **Orchards and Forest: Area E of Perth** | | | | | | | | | | | |
| 1 | 6/71 | ⎫ Pickering Brook | ♂ | 0+ | ? | 42.0cm | Forest | 0.61 | 0.04 | 0.35 | 0.01 |
| 2 | 6/71 | ⎭ Pickering Brook | ♀ | 1+ | ? | 39.5cm | Forest | 1.93 | 0.03 | 0.75 | 0.01 |
| 111 | 2/72 | ⎫ Karragullen | ♂ | 0+ | 295g | 40.5cm | Orchards | 3.6 | 1.8 | 0.8 | 0.3 |
| 112 | 2/72 | ⎭ Karragullen | ♂ | 1+ | 305g | 42.0cm | Orchards | 6.8 | 1.1 | 3.8 | 0.6 |
| 113 | 2/72 | Pickering Brook | ♂ | >4 yrs | 330g | 43.0cm | Orchards | 9.8 | 0.4 | 3.8 | 0.4 |
| 114 | 2/72 | Pickering Brook | ♀ | 1+ | 290g | 39.5cm | Orchards | 0.2 | 0.06 | 0.2 | 0.03 |
| 115 | 2/72 | ⎫ Hacketts Gully | ♂ | 2+ | 295g | 39.5cm | Orchards | 25.0 | 0.18 | 9.0 | 0.01 |
| 116 | 2/72 | ⎭ Hacketts Gully | ♀ | 1+ | 265g | 40.5cm | Orchards | 1.7 | 0.1 | 1.2 | 0.02 |
| 117 | 2/72 | Mundaring Weir | ♂ | 0+ | 295g | 43.0cm | Forest/Orchard | 0.5 | 0.1 | 0.3 | 0.01 |
| 118 | 2/72 | Pickering Brook | ♂ | >>4 yrs | 335g | 42.5cm | Orchard | 8.2 | 0.05 | 14.0 | 0.1† |
| **Armadale-Serpentine** | | | | | | | | | | | |
| 67 | 7/71 | Armadale | ♂ | 2+ | 285g | 41.5cm | Pasture | 0.1 | 0.4 | 0.04 | 0.03 |
| 68 | 7/71 | Armadale | ♀ | 2+ | 265g | 38.5cm | Pasture | 1.2 | 0.5 | 0.3 | 0.07 |
| 69 | 7/71 | ⎫ Byford | ♂ | >4 | 270g | 43.0cm | P | 0.01 | 0.01 | <0.01 | <<0.01 |
| 70 | 7/71 | ⎭ Byford | ♀ | 2+ | 320g | 41.5cm | P | 0.03 | 0.02 | 0.01 | <<0.01 |
| 73 | 7/71 | Serpentine | ♂ | 3+ | 308g | 38.5cm | P | 0.07 | 0.01 | 0.03 | <<0.01 |
| 110(136) | 2/72 | Serpentine | ♀ | 2+ | 260g | 37.5cm | P | 0.01 | 0.01 | 0.05 | <0.01 |
| 147 | 10/72 | Byford | ♂ | Adult | [300g] | 39.5cm | Townsite | 0.2 | 0.05 | 0.08 | 0.02 |
| **Keysbrook-Dwellingup-Pinjarra-Mandurah-Waroona** | | | | | | | | | | | |
| γ | 12/70 | Greensland Rd, Pinjarra | ? | ? | ? | ? | P | 0.01 | <0.01 | <0.01 | <<0.01 |
| 120 | 2/71 | Greensland Rd, Pinjarra | ? | 0+? | [285g] | 38.5cm | P | 0.01 | 0.01 | <0.01 | <<0.01 |
| β | 12/70 | Robert Bay, Peel Inlet | ? | ? | ? | ? | P | 0.01+ | <<0.01 | <0.01 | <<0.002 |

| | | | | | | | | Liver | | Muscle | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 119 | 2/71 | Heron Point area, Harvey Estuary | ♂ | 2+ | [335g] | 42.0cm | P | 0.02 | 0.02 | <0.01 | <<0.01 |
| α | 12/70 | SE Corner, Harvey Estuary | ? | ? | ? | ? | P | 0.18 | 0.01 | 0.05+ | <<0.01 |
| γ | 2/71 | Mandurah district | ? | ? | ? | ? | P | 0.04 | 0.04 | 0.01+ | a [<<0.01] |
| 121 | 2/71 | Mandurah district | ♂ | 3+ | [370g] | 41.5cm | P | <0.01 | 0.01 | <0.01 | <<0.01 |
| × | 12/70 | Lakeside area, Mandurah district | ? | ? | ? | ? | P | 0.02 | 0.01 | 0.02 | 0.01 |
| 3 | 7/71 | Pinjarra | ♂ | >4 | 290 | 39.5cm | P | 0.08 | 0.02 | 0.02+ | 0.01 |
| 5 | 7/71 | Waroona | ♂ | >4 | 290 | 42.0cm | P | 0.32 | 0.02 | 0.08 | 0.01 |
| 6 | 7/71 | Waroona | ♀ | 4 | 290 | 40.5cm | P | 0.04 | 0.01 | 0.01+ | <0.01 |
| 8 | 7/71 | Yarloop | ♂ | 5 | 325 | 42.5cm | P | 0.02+ | 0.01 | 0.01+ | <0.01 |
| 65 | 7/71 | Isandra (Dwellingup) | ♂ | 2+ | 300 | 39.0cm | P | 0.01 | <0.01 | 0.02 | <<0.01 |
| 66 | 7/71 | Coolup | ♂ | 1+ | 295 | 41.0cm | P/B | <0.01 | <0.01 | <<0.01 | <<0.01 |
| 71 | 7/71 | North Dandalup | ♂ | >4 | 303 | 42.5cm | P | 0.06 | 0.02 | 0.01 | <0.01 |
| 72 | 7/71 | North Dandalup | ♂ | 2+ | 305 | 43.5cm | P | 0.06 | 0.03 | 0.02 | 0.01 |
| **Waterloo-Dardanup-Capel** | | | | | | | | | | | |
| 10 | 7/71 | Waterloo | ♀ | 2+ | 290 | 39.5cm | Pi | 0.06 | 0.02 | 0.02 | <0.01 |
| 11 | 7/71 | Dardanup | ♂ | <4 | 325 | 42.5cm | Pi | 0.07 | 0.03 | 0.05 | <0.01 |
| 12 | 7/71 | Dardanup | ♀ | 2+ | 310g | 39.5cm | P/b | 0.05 | 0.02 | 0.05 | 0.02 |
| 19 | 7/71 | Capel | ♂ | 2+ | 290g | 41.5cm | P | 0.01+ | 0.01 | <0.01 | <0.001 |
| 139 | 10/72 | Capel | ♂ | Adult (>4) | [360g] | 42.0cm | Townsite | 0.02 | 0.01 | 0.01 | <0.01 |
| **Donnybrook District** | | | | | | | | | | | |
| 16 | 7/71 | Lowden | ♂ | ≧5+ | 295g | 41.0cm | P | 0.41 | 0.22 | 0.16 | 0.03 |
| 17 | 7/71 | Donnybrook | ♀ | 2+ | 295g | 41.0cm | P/Orchard | 1.80 | 0.60 | 0.90 | 0.30 |
| 18 | 7/71 | ~15 km SW of Donnybrook | ♂ | 2+ | 260g | 41.0cm | P | 0.19 | 0.10 | 0.06 | <0.01 |
| **Busselton-Augusta** | | | | | | | | | | | |

| | | | | | | | | Liver | | Muscle | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 7/71 | Busselton | ♀ | 0+ | 270g | 39.5cm | P | <0.01 | 0.03 | <<0.01 | 0.01 |
| 21 | 7/71 | Carbunup or Marybrook | ♂ | 0+ | 310g | 41.5cm | P | 0.16 | 0.30 | 0.05 | 0.10 |
| 22 | 7/71 | Carbunup or Marybrook | ♂ | >4 | 310g | 42.0cm | P | 0.28 | 0.08 | 0.13 | 0.03 |
| 23 | 7/71 | Yallingup | ♂ | 0+ | 280g | 41.5cm | Forest | 0.03 | 0.10 | 0.01+ | 0.02 |
| 24 | 7/71 | Yallingup | ♀ | 2+ | 335g | 40.5cm | P/F | 0.04 | 0.08 | 0.03 | 0.02 |
| 25 | 7/71 | Mammoth Cave | ♀ | 2+ | 315g | 42.0cm | Forest | 0.05 | 0.02 | 0.03 | 0.01 |
| 26 | 7/71 | Mammoth Cave | ♂ | 2+ | 315g | 43.0cm | Forest | 0.08 | 0.02 | 0.04 | 0.01 |
| 27 | 7/71 | Alexandra Bridge | ♂ | >4 | 300g | 43.0cm | P/F ? | 0.04 | 0.03 | 0.04 | 0.02 |
| **Nannup-Mullalyup-Boyup Brook-Manjimup-Pemberton** | | | | | | | | | | | |
| 28 | 7/71 | Nannup | ♀ | ≧2+ | 300g | 39.5cm | P/F | 6.82 | 3.1 | 3.4 | 1.5 |
| 29 | 7/71 | W of Bridgetown | ♀ | 1+ | 240g | 39.5cm | P | 0.03 | 0.01 | 0.04 | 0.01 |
| 30 | 7/71 | W of Bridgetown | ♀ | 4+ | 300g | 41.0cm | P | 0.10 | 0.01 | 0.05 | 0.01 |
| 31 | 7/71 | Balingup | ♂ | >4 | 305g | 40.5cm | P/F | 0.13 | 0.04 | 0.03 | 0.01 |
| 32 | 7/71 | W of Boyup Brook | ♂ | 4+ | 315g | 42.0cm | P | 0.02 | 0.14 | 0.03 | 0.03 |
| 33 | 7/71 | W of Boyup Brook | ♂ | ≧5+ | 265g | 40.5cm | P | 0.54 | 0.16 | 0.15 | 0.04 |
| 34 | 7/71 | Palgarup | ♂ | >4 | 320g | 41.0cm | Townsite | 0.13 | 0.14 | 0.04 | 0.02 |
| 35 | 7/71 | Palgarup | ♀ | 3+ | 260g | 38.0cm | Townsite | 0.06 | 0.14 | 0.02 | 0.07 |
| 36 | 7/71 | Pemberton | ♂ | 1+ | 280g | 38.0cm | Townsite | 1.25 | 0.05 | 0.27 | 0.01 |
| 37 | 7/71 | Pemberton | ♂ | >4 | 265g | 41.5cm | P/F | 0.70 | 1.00 | 0.10 | 0.10 |
| **Mt Barker-Denmark-Albany** | | | | | | | | | | | |
| 38 | 7/71 | SW of Mt Barker | ♂ | >4 | 340g | 42.0cm | P/B | 0.06 | 0.02 | 0.04 | <0.01 |
| 39 | 7/71 | SW of Mt Barker | ♂ | 1+ | 305g | 40.5cm | P/B | 0.05 | 0.20 | 0.04 | 0.01 |
| 40 | 7/71 | Mt Barker | ♂ | 1+ | 295g | 42.0cm | P/B | 0.10 | 0.04 | 0.05 | 0.01 |
| 41 | 7/71 | Albany nr Airstrip | ♂ | 2+ | 320g | 42.5cm | P | 0.08 | 0.01 | 0.06 | 0.01 |
| 42 | 7/71 | Bornholm | ♂ | >4 | 335g | 43.0cm | P | 0.20 | 0.10 | 0.05 | <0.01 |
| 43 | 7/71 | Bornholm | ♂ | >4 | 305g | 43.5cm | P/B | 0.30 | 0.10 | 0.09 | <0.01 |
| 44 | 7/71 | Kendenup | ♂ | >4 | 305g | 43.0cm | P/B | 0.40 | 0.05 | 0.20 | <0.01 |
| 45 | 7/71 | Kendenup | ♂ | >4 | 315g | 43.0cm | P/B | 0.20 | 0.02 | 0.20 | <0.01 |

| | | | | | | | | Liver | | Muscle | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Qualeup-Frankland-Rocky Gully** | | | | | | | | | | | |
| 46 | 7/71 | W of Cranbrook | ♂ | 1+ | 305g | 40.5cm | P | 0.06 | 0.02 | 0.10 | 0.01 |
| 47 | 7/71 | Rocky Gully | ♀ | 1+ | 305g | 41.0cm | P | 0.04 | <0.01 | 0.05 | <0.01 |
| 48 | 7/71 | Rocky Gully | ♂ | 1+ | 290g | 40.5cm | P | 0.04 | <0.01 | 0.06 | <0.01 |
| 49 | 7/71 | Frankland | ♂ | >4 | 300g | 42.0cm | P | 0.20 | <0.01 | 0.10 | <0.01 |
| 50 | 7/71 | Riversdale | ♂ | >4 | 285g | 41.5cm | P | 0.04 | <0.01 | 0.02 | <0.01 |
| 51 | 7/71 | E of Mobrup | ♂ | 2+ | 315g | 40.5cm | P/B | 0.02 | <0.01 | 0.02 | <0.01 |
| 52 | 7/71 | W of Jingalup | ♂ | 1+ | 305g | 38.0cm | P | 0.10 | <0.01 | 0.04 | <0.01 |
| 53 | 7/71 | Narlingup | ♂ | >4 | 360g | 43.5cm | P | 0.05 | <0.01 | 0.01 | <0.01 |
| **Mumballup-Collie-Darkan-Duranillin** | | | | | | | | | | | |
| 15 | 7/71 | Glen Mervyn | ♂ | >4 | 350g | 41.5cm | P | 0.01+ | 0.01 | <0.01 | <0.01 |
| 14 | 7/71 | Cardiff | ♂ | >4 | 280g | 41.5cm | Forest | 0.09+ | 0.02 | 0.05+ | 0.01 |
| 13 | 7/71 | Collie | ♂ | >4 | 290g | 43.5cm | Townsite | 0.02 | 0.02 | 0.01+ | <0.01 |
| 54 | 7/71 | Capercup | ♂ | 1+ | 305g | 40.5cm | P | 0.10 | 0.02 | 0.04 | <<0.01 |
| 55 | 7/71 | Muja | ♂ | >4 | 340g | 43.0cm | P | 0.02 | <<0.01 | <0.01 | <<0.01 |
| 56 | 7/71 | Bowelling | ♀ | 2+ | 290g | 40.5cm | P | 0.01 | <<0.01 | <0.01 | <<0.01 |
| 57 | 7/71 | Boolading | ♀ | 2+ | 300g | 40.5cm | P | 0.01 | <<0.01 | 0.01 | <<0.01 |
| 58 | 7/71 | Darkan | ♂ | 6+ | 355g | 42.0cm | P | 0.02 | <0.01 | 0.01 | <<0.01 |
| **Williams-Boddington** | | | | | | | | | | | |
| 59 | 7/71 | Williams | ♂ | >5 | 310g | 41.5cm | P | 0.01 | 0.01 | 0.01 | <<0.01 |
| 60 | 7/71 | SW of Williams | ♂ | 1+ | 250g | 39.5cm | P | 0.10 | <<0.01 | 0.03 | <<0.01 |
| 61 | 7/71 | Quindanning | ♀ | ≧3+ | 315g | 41.0cm | P | <0.01 | <<0.01 | <0.01 | <<0.01 |
| 62 | 7/71 | S of Boddington | ♂ | 2+ | 300g | 42.5cm | P/B | <0.01 | <<0.01 | <0.01 | <<0.01 |
| 63 | 7/71 | SW of Boddington | ♂ | <5 | 295g | 42.5cm | P/B | <0.01 | <<0.01 | <<0.01 | <<0.01 |
| 64 | 7/71 | SW of Boddington | ♂ | 2+ | 295g | 41.5cm | P/B | <0.01 | <<0.01 | <0.01 | <<0.01 |

(110)

# Table 1

North of Perth

| Bird Samples No | Date Coll | Coll Locality | Sex | Age Class | Body Weight | Length | Habitat type | Liver DDT+Metab | Liver Dieldrin | Muscle DDT | Muscle Dieldrin | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 75 | 8/71 | Mingenew | ♂ | 2+ | 315 g | 42.0 cm | Farmland | 0.01+ | 0.01 | 2 | 2 | |
| 76 | 8/71 | Mingenew | ♂ | 2+ | 275 g | 40.5 cm | Farmland | 0.03 | 0.01 | 0.01+ | 2 | |
| 80 | 8/71 | Mingenew | ♂ | 1+ | 275 g | 42.0 cm | Farmland | 0.02+ | 0.02 | 2 | 2 | Hc |
| | 12/70 | Moorhouse | ? | ? | ? | ? | Farmland | 0.02+ | <0.01 | 0.01 | <0.01 | |
| | 12/70 | Watheroo | ? | ? | ? | ? | Farmland | No sample | | 0.03 | 0.02 | |
| | 12/70 | Guildertan | ? | ? | ? | ? | Farmland | 0.02 | 0.43 | 0.01+ | 0.11 | ✓ |
| Perth urban area — Donnelly End | 12/71 | Claremont | ? | ? | ? | ? | Home Garden | DDE 12.0 | 19.0 | 9.6 | 13.0 | * |
| 123 | 10/72 | Metro Area | ♂ | Adult (Whitened) | [355 g] | 41.0 cm | Urban | 2.0 | 1.7 | 0.4 | 0.3 | |
| 126 | 10/72 | Como | ♂ | Adult [4+] | [350 g] | 43.0 cm | Urban | 3.2 | 1.0 | 0.9 | 0.2 | |
| 129 | 10/72 | Morley | ♂ | Adult [4+] | [325 g] | 40.0 cm | Urban ?[fringe] | 1.2 | 1.5 | 0.4 | 0.2 | |
| 134 | 10/72 | Como | ?(?) | ? 1+ | [375 g] | 44.0 cm | Urban | L=No Sample available | | 4.2 | 3.2 | |
| 140 | 10/72 | Willetton ? | ? | 2+ | [245 g] | 41.5 | Urban | ? 33.0 | 12.0 | 2.3 | 1.1 | |
| 141 | 10/72 | Viveash | ♂ | Adult [3+] | [355 g] | 40.7 cm | Urban fringe | 1.7 | 0.2 | 0.4 | 0.1 | |
| 143 | 10/72 | Viveash | ♂ | 1+ | [340 g] | 39.5 cm | Urban fringe | 1.7 | 0.2 | 0.3 | 0.03 | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 142 | 10/72 | Metro Area | ♂ | Adult | [340g] | 38.0 cm | ?Urban fringe | 0.5 | 0.5 ✓ | 0.3 | 0.2 |
| 144 | 10/72 | North Beach | ♂ | Adult | [330g] | 39.0 cm | Urban | 3.8 | 2.2 ✓ | 1.2 | 0.3 |
| 145 | 10/72 | Morley | ♂ | Adult | [375g] | 42.0 cm | Urban fringe | 0.6 | 0.2 ✓ | 0.4 | 0.1 |
| 146 | 10/72 | Balga | ♂ | Adult | [335g] | 43.5 cm | Urban fringe | 0.5 | 0.3 ✓ | 0.4 | 0.1 |
| 125 | 11/72 | Metro Area | ♀ | 2+ | [358g] | 40.0 cm | Urban | 3.4 | 3.4 ✓ | 0.4 | 0.5 |
| 128 | 11/72 | Claverdale ✓ | ♂ | 1+ ✓ | [285g] | 37.0 cm ✓ | Urban ✓ | 1.7 ✓ | 1.7 ✓ | 0.4 ✓ | 0.4 |
| 122 | 4/73 | Scarborough | ♂ | Adult | [325g] | 42.5 cm | Urban (fringe) | 0.02 | 0.01 | 0.02 | <<0.01 ✓ |
| Orchard / Area E of Perth & Forest | | | | | | | | | | | |
| 1 | 6/71 | Pickering Brook | ♂ | 0+ | ? | 42.0 cm | Forest | 0.61 | 0.04 | 0.35 | 0.01 |
| 2 | 6/71 | Pickering Brook | ♀ | 1+ | ? | 39.5 cm | Forest | 1.93 | 0.03 | 0.75 | 0.01 |
| × 111 | 2/72 | Kanuguluup | ♂ | 0+ | 295g | 40.5 cm | Orchards | 3.6 | 1.8 | 0.8 | 0.3 |
| × 112 | 2/72 | Kanuguluup | ♂ | 1+ | 305g | 42.0 cm | Orchards | 6.8 | 1.1 | 3.8 | 0.6 |
| × 113 | 2/72 | Pickering Brook | ♂ | >4 yrs | 330g | 43.0 cm | Orchards | 9.8 | 0.4 | 3.8 | 0.4 |
| × 114 | 2/72 | Pickering Brook | ♀ | 1+ | 290g | 39.5 cm | Orchards | 0.2 | 0.06 | 0.2 | 0.03 |
| × 115 | 2/72 | Hackett's Gully | ♀ | 2+ | 295g | 39.5 cm | Orchards | 25.0 | 0.18 | 9.0 | 0.01 |
| × 116 | 2/72 | Hackett's Gully | ♂ ✓ | 1+ ✓ | 265g | 40.5 cm | Orchards | 1.7 ✓ | 0.1 | 1.2 | 0.07 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 117 | | 2/72 | Mundaring Weir | ♂ | 0+ | 295g | 43.0 cm | Forest/orchard | 0.5 | 0.1 | 0.3 | 0.01 |
| ϕ | 118 | | 2/72 | Pickering Brook | ♂ | >>4yrs | 335g | 42.5 cm | Orchard | 8.2 | 0.05 | 14.0 | 0.1 † |
| | | Armadale — Serpentine | | | | | | | | | | | |
| | 67 | | 7/71 | Armadale | ♂ | 2+ | 285g | 41.5 cm | Pasture | 0.1 | 0.4 | 0.04 | 0.03 |
| | 68 | | 7/71 | Armadale | ♀ | 2+ | 265g | 38.5 cm | Pasture | 1.2 | 0.5 | 0.3 | 0.07 |
| | 69 | | 7/71 | Byford | ♂ | >4 | 270g | 43.0 cm | P | 0.01 | 0.01 | <0.01 | ≪0.01 |
| | 70 | | 7/71 | Byford | ♀ | 2+ | 320g | 41.5 cm | P | 0.03 | 0.02 | 0.01 | ≪0.01 |
| | 73 | | 7/71 | Serpentine | ♂ | 3+ | 308g | 38.5 cm | P | 0.07 | 0.01 | 0.03 | ≪0.01 |
| | 110(136) | | 2/72 | Serpentine | ♀ | 2+ | 260g | 37.5 cm | P | 0.01 | 0.01 | 0.05 | <0.01 |
| | 147 | | 10/72 | Byford | ♂ | Adult | [300g] | 39.5 cm | Townsite | 0.2 | 0.05 | 0.08 | 0.02 |
| | | Kaysbrook — Dwellingup<br>Pinjarra — Mandurah<br>Waroona | | | | | | | | | | | |
| γ | | | 12/70 | Greenland Rd, Pinjarra | ? | ? | ? | ? | P | 0.01 | <0.01 | ≪0.01 | ≪0.01 |
| 120 | | | 2/71 | Greenland Rd, Pinjarra | ? | 0+? | [285g] | 38.5 cm | P | 0.01 | 0.01 | <0.01 | ≪0.01 |
| β | | | 12/70 | Robert Bay, Peel Inlet | ? | ? | ? | ? | P | 0.01 | <0.01 | <0.01 | ≪0.01 |
| 119 | | | 2/71 | Heron Point area, Harvey Estuary | ♂ | 2+ | [335g] | 42.0 cm | P | 0.02 | 0.02 | <0.01 | ≪0.01 |
| α | | * of S | 12/70 | SE corner, Harvey Estuary | ? | ? | ? | ? | P | 0.18 | 0.01 | 0.05 † | ≪0.01 |
| γ | | | 2/71 | Mandurah district | ? | ? | ? | ? | P | 0.04 | 0.04 | 0.01 † | 2 [≪0.01] |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 121 | | 2/71 | Mandurah district | ♂ | 3+ | [370g] | 41.5cm | P | <0.01 | 0.01 | <0.01 | <<0.01 |
| X | | 12/70 | Lakeside area, Mandurah district | ? | ? | ? | ? | P | 0.02 | 0.01 | 0.02 | 0.01 |
| 3 | | 7/71 | Pinjarra | ♂ | >4 | 290 | 39.5cm | P | 0.08 | 0.02 | 0.02+ | 0.01 |
| 5 | * | 7/71 | Waroona | ♂ | >4 | 290 | 42.0cm | P | 0.32 | 0.02 | 0.08 | 0.01 |
| 6 | | 7/71 | Waroona | ♀ | 4 | 290 | 40.5cm | P | 0.04 | 0.01 | 0.01+ | <0.01 |
| 8 | | 7/71 | Yarloop | ♂ | 5 | 325 | 42.5cm | P | 0.02+ | 0.01 | 0.01+ | <0.01 |
| 65 | | 7/71 | Isandra (Dwellingup) | ♂ | 2+ | 300 | 39.0cm | P | 0.01 | <0.01 | 0.02 | <<0.01 |
| 66 | | 7/71 | Coolup | ♂ | 1+ | 295 | 41.0cm | P/I | <0.01 | <0.01 | <<0.01 | <<0.01 |
| 71 | | 7/71 | North Dandalup | ♂ | >4 | 303 | 42.5cm | P | 0.06 | 0.02 | 0.01 | <0.01 |
| 72 | | 7/71 | North Dandalup | ♂ | 2+ | 305 | 43.5cm | P | 0.06 | 0.03 | 0.02 | 0.01 |
| | | | Waterloo - Dandalup Capel | | | | | | | | | |
| 10 | | 7/71 | Waterloo | ♀ | 2+ | 290 | 39.5cm | $P_I$ | 0.06 | 0.02 | 0.02 | <0.01 |
| 11 | | 7/71 | Dandalup | ♂ | >4 | 325 | 42.5cm | $P_I$ | 0.07 | 0.03 | 0.05 | <0.01 |
| 12 | | 7/71 | Dandalup | ♀ | 2+ | 310g | 39.5cm | P/I | 0.05 | 0.02 | 0.05 | 0.02 |
| 19 | | 7/71 | Capel | ♂ | 2+ | 290g | 41.5cm | P | 0.01+ | 0.01 | <0.01 | <0.01 |
| 139 | | 10/72 | Capel | ♂ | Adult (>4) | [360g] | 42.0cm | Transitie | 0.02 | 0.01 | 0.01 | <0.01 |

## Donnybrook district

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | | 7/71 | Lowden | ♂ | ≥5+ | 295g | 41.0cm | P | 0.41 | 0.22 | 0.16 | 0.03 |
| * 17 | | 7/71 | Donnybrook | ♀ | 2+ | 295g | 41.0cm | P/orch | 1.80 | 0.60 | 0.90 | 0.30 |
| 18 | | 7/71 | ~15km SW of Donnybrook | ♂ | 2+ | 260g | 41.0 cm | P | 0.19 | 0.10 | 0.06 | <0.01 |

## Busselton-Augusta

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | ?Not tested (No carcase available) | 7/71 | Busselton | ♀ | 0+ | 270g | 39.5cm | P | <0.01 | 0.03 | <0.01 | 0.01 |
| 21 | | 7/71 | Carbunup or Marybrook | ♂ | 0+ | 310g | 41.5cm | P | 0.16 | 0.30 | 0.05 | 0.10 |
| * 22 | * lindane 0.01 kgm. | 7/71 | Carbunup or Marybrook | ♂ | >4 | 310g | 42.0cm | P | 0.28 | 0.08 | 0.13 | 0.03 |
| • 23 | trace lindane kgm | 7/71 | Yallingup | ♂ | 0+ | 280g | 41.5cm | Forest | 0.03 | 0.10 | 0.01+ | 0.02 |
| 24 | No lindane | 7/71 | Yallingup | ♀ | 2+ | 335g | 40.5cm | P/F | 0.04 | 0.08 | 0.03 | 0.02 |
| • 25 | trace lindane kgm | 7/71 | Mammoth Cave | ♀ | 2+ | 315g | 42.0cm | Forest | 0.05 | 0.02 | 0.03 | 0.01 |
| • 26 | trace lindane kgm | 7/71 | Manell Cave | ♂ | 2+ | 315g | 43.0cm | Forest | 0.08 | 0.02 | 0.04 | 0.01 |
| 27 | No lindane | 7/71 | Alexandra Bridge | ♂ | >4 | 300g | 43.0cm | P/F | 0.04 | 0.03 | 0.04 | 0.02 |

## Nannup - Mullalyup - Boyup Brook - Manjimup - Pemberton

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | No lindane | 7/71 | Nannup | ♀ | ≥2+ | 300g | 39.5cm | P/F | 6.82 | 3.1 | 3.4 | 1.5 |
| • 29 | trace lindane kgm only | 7/71 | Wolf Bridgetown | ♀ | 1+ | 240g | 39.5cm | P | 0.03 | 0.01 | 0.04 | 0.01 |
| 30 | No lindane | 7/71 | Wolf Bridgetown | ♀ | 4+ | 300g | 41.0cm | P | 0.10 | 0.01 | 0.05 | 0.01 |
| 31 | No lindane | 7/71 | Balingup | ♂ | >4 | 305g | 40.5 cm | P/F | 0.13 | 0.04 | 0.03 | 0.01 |
| 32 | No lindane | 7/71 | W of Boyup Brook | ♂ | 4+ | 315g | 42.0 cm | P | 0.02 | 0.14 | 0.03 | 0.03 |
| * 33 | lindane kgm 0.02 M 0.01 | 7/71 | W of Boyup Brook | ♂ | ≥5+ | 265g | 40.5cm | P | 0.54 | 0.16 | 0.15 | 0.04 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 34 | Trace hindcare hardy | 7/71 | Palgarup | ♂ | >4 | 320 g | 41.0 cm | Tawnsite | 0.13 | 0.14 | 0.04 | 0.02 |
| 35 | Trace hindcare hardy | 7/71 | Palgarup | ♀ | 3+ | 260 g | 38.0 cm | Tawnsite | 0.06 | 0.14 | 0.02 | 0.07 |
| 36 | No hindcare | 7/71 | Pemberton | ♂ | 1+ | 280 g | 38.0 cm | Tawnsite | 1.25 | 0.05 | 0.27 | 0.01 |
| 37 | No other OCs detected | 7/71 | Pemberton | ♂ | >4 | 265 g | 41.5 cm | P/F | 0.70 | 1.00 | 0.10 | 0.10 |

Mt Barker - Denmark - Albany

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 38 | No other OCs detected | 7/71 | SW of Mt Barker | ♂ | >4 | 340 g | 42.0 cm | P/B | 0.06 | 0.02 | 0.04 | <0.01 |
| 39 | | 7/71 | SW of Mt Barker | ♂ | 1+ | 305 g | 40.5 cm | P/B | 0.05 | 0.20 | 0.04 | 0.01 |
| 40 | | 7/71 | Mt Barker | ♂ | 1+ | 295 g | 42.0 cm | P/B | 0.10 | 0.04 | 0.05 | 0.01 |
| 41 | | 7/71 | Albany nr Airstrip | ♂ | 2+ | 320 g | 42.5 cm | P | 0.08 | 0.01 | 0.06 | 0.01 |
| 42 | | 7/71 | Barnholm | ♂ | >4 | 335 g | 43.0 cm | P | 0.20 | 0.10 | 0.05 | <0.01 |
| 43 | | 7/71 | Barnholm | ♂ | >4 | 305 g | 43.5 cm | P/B | 0.30 | 0.10 | 0.09 | <0.01 |
| 44 | | 7/71 | Kendenup | ♂ | >4 | 305 g | 43.0 cm | P/B | 0.40 | 0.05 | 0.20 | <0.01 |
| 45 | | 7/71 | Kendenup | ♂ | >4 | 315 g | 43.0 cm | P/B | 0.20 | 0.02 | 0.20 | <0.01 |

Quaalup - Frankland - Rocky Gully

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 46 | | 7/71 | W of Cranbrook | ♂ | 1+ | 305 g | 40.5 cm | P | 0.06 | 0.02 | 0.10 | 0.01 |
| 47 | | 7/71 | Rocky Gully | ♀ | 1+ | 305 g | 41.0 cm | P | 0.04 | <0.01 | 0.05 | <0.01 |
| 48 | | 7/71 | Rocky Gully | ♂ | 1+ | 290 g | 40.5 cm | P | 0.04 | <0.01 | 0.06 | <0.01 |
| 49 | | 7/71 | Frankland | ♂ | >4 | 300 g | 42.0 cm | P | 0.20 | <0.01 | 0.10 | <0.01 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | Noothet carcass O/c's deleted | 7/71 | ? Riversdale | ♂ | >4 | 285 g | 41.5 cm | P | 0.04 | <0.01 | 0.02 | <0.01 |
| 51 | | 7/71 | E of Mobrup | ♂ | 2+ | 315 g | 40.5 cm | P/B | 0.02 | <0.01 | 0.02 | <0.01 |
| 52 | | 7/71 | W of Jingalup | ♂ | 1+ | 305 g | 38.0 cm | P | 0.10 | <0.01 | 0.04 | <0.01 |
| 53 | | 7/71 | Narlingup | ♂ | >4 | 360 g | 43.5 cm | P | 0.05 | <0.01 | 0.01 | <0.01 |
| | Mumballup – Collie – Darkan – Duranillin | | | | | | | | | | | |
| 15 | | 7/71 | Glen Mervyn | ♂ | >4 | 350 g | 41.5 cm | P | 0.01+ | 0.01 | <0.01 | <0.01 |
| 14 | | 7/71 | Cardiff | ♂ | >4 | 280 g | 41.5 cm | Forest | 0.09+ | 0.02 | 0.05+ | 0.01 |
| 13 | | 7/71 | Collie | ♂ | >4 | 290 g | 43.5 cm | Townsite | 0.02 | 0.02 | 0.01+ | <0.01 |
| 54 | | 7/71 | Capercup | ♂ | 1+ | 305 g | 40.5 cm | P | 0.10 | 0.02 | 0.04 | <<0.01 |
| 55 | | 7/71 | Muja | ♂ | >4 | 340 g | 43.0 cm | P | 0.02 | <<0.01 | <0.01 | <<0.01 |
| 56 | | 7/71 | Bowelling | ♀ | 2+ | 290 g | 40.5 cm | P | 0.01 | <<0.01 | <0.01 | <<0.01 |
| 57 | | 7/71 | Boolgeling | ♀ | 2+ | 300 g | 40.5 cm | P | 0.01 | <<0.01 | 0.01 | <<0.01 |
| 58 | | 7/71 | Darkan | ♂ | 6+ | 355 g | 42.0 cm | P | 0.02 | <0.01 | 0.01 | <<0.01 |
| | Williams – Boddington | | | | | | | | | | | |
| 59 | | 7/71 | Williams | ♂ | >5 | 310 g | 41.5 cm | P | 0.01 | 0.01 | 0.01 | <<0.01 |
| 60 | | 7/71 | SW of Williams | ♂ | 1+ | 250 g | 39.5 cm | P | 0.10 | <<0.01 | 0.03 | <<0.01 |
| 61 | | 7/71 | Quindanning | ♀ | ≥3+ | 315 g | 41.0 cm | P | <0.01 | <<0.01 | <0.01 | <<0.01 |
| 62 | | 7/71 | S of Boddington | ♂ | 2+ | 300 g | 42.5 cm | P/B | <0.01 | <<0.01 | <0.01 | <<0.01 |
| 63 | | 7/71 | SW of Boddington | ♂ | >5 | 295 g | 42.5 cm | P/B | <0.01 | <<0.01 | <<0.01 | <<0.01 |
| 64 | | 7/71 | SW of Boddington | ♂ | 2+ | 295 g | 41.5 cm | P/B | <0.01 | <<0.01 | <0.01 | <<0.01 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Qualup-Frankland** | | | | | | | | | | | |
| **Rocky Gully** | | | | | | | | | | | |
| 46 | 7/71 | W of Cranbrook | ♂ | 1+ | 305g | 40.5cm | P | 0.06 | 0.02 | 0.10 | 0.01 |
| 47 | 7/71 | Rocky Gully | ♀ | 1+ | 305g | 41.0cm | P | 0.04 | <0.01 | 0.05 | <0.01 |
| 48 | 7/71 | Rocky Gully | ♂ | 1+ | 290g | 40.5cm | P | 0.04 | <0.01 | 0.06 | <0.01 |
| 49 | 7/71 | Frankland | ♂ | >4 | 300g | 42.0cm | P | 0.20 | <0.01 | 0.10 | <0.01 |
| 50 | 7/71 | Riversdale | ♂ | >4 | 285g | 41.5cm | P | 0.04 | <0.01 | 0.02 | <0.01 |
| 51 | 7/71 | E of Mobrup | ♂ | 2+ | 315g | 40.5cm | P/B | 0.02 | <0.01 | 0.02 | <0.01 |
| 52 | 7/71 | W of Jingalup | ♂ | 1+ | 305g | 38.0cm | P | 0.10 | <0.01 | 0.04 | <0.01 |
| 53 | 7/71 | Narlingup | ♂ | >4 | 360g | 43.5cm | P | 0.05 | <0.01 | 0.01 | <0.01 |
| **Mumballup-Collie** | | | | | | | | | | | |
| **Darkan-Duranillin** | | | | | | | | | | | |
| 15 | 7/71 | Glen Mervyn | ♂ | >4 | 350g | 41.5cm | P | 0.01+ | 0.01 | <0.01 | <0.01 |
| 14 | 7/71 | Cardiff | ♂ | >4 | 280g | 41.5cm | Forest | 0.09+ | 0.02 | 0.05+ | 0.01 |
| 13 | 7/71 | Collie | ♂ | >4 | 290g | 43.5cm | Townsite | 0.02 | 0.02 | 0.01+ | <0.01 |
| 54 | 7/71 | Capercup | ♂ | 1+ | 305g | 40.5cm | P | 0.10 | 0.02 | 0.04 | <<0.01 |
| 55 | 7/71 | Muja | ♂ | >4 | 340g | 43.0cm | P | 0.02 | <<0.01 | <0.01 | <<0.01 |
| 56 | 7/71 | Bowelling | ♀ | 2+ | 290g | 40.5cm | P | 0.01 | <<0.01 | <0.01 | <<0.01 |
| 57 | 7/71 | Boolading | ♀ | 2+ | 300g | 40.5cm | P | 0.01 | <<0.01 | 0.01 | <<0.01 |
| 58 | 7/71 | Darkan | ♂ | 6+ | 355g | 42.0cm | P | 0.02 | <0.01 | 0.01 | <<0.01 |
| **Williams-Boddington** | | | | | | | | | | | |
| 59 | 7/71 | Williams | ♂ | >5 | 310g | 41.5cm | P | 0.01 | 0.01 | 0.01 | <<0.01 |
| 60 | 7/71 | SW of Williams | ♂ | 1+ | 250g | 39.5cm | P | 0.10 | <<0.01 | 0.03 | <<0.01 |
| 61 | 7/71 | Quindanning | ♀ | ≧3+ | 315g | 41.0cm | P | <0.01 | <<0.01 | <0.01 | <<0.01 |
| 62 | 7/71 | S of Boddington | ♂ | 2+ | 300g | 42.5cm | P/B | <0.01 | <<0.01 | <0.01 | <<0.01 |
| 63 | 7/71 | SW of Boddington | ♂ | <5 | 295g | 42.5cm | P/B | <0.01 | <<0.01 | <<0.01 | <<0.01 |
| 64 | 7/71 | SW of Boddington | ♂ | 2+ | 295g | 41.5cm | P/B | <0.01 | <<0.01 | <0.01 | <<0.01 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 7/71 | Busselton | ♀ | 0+ | 270g | 39.5cm | P | <0.01 | 0.03 | <<0.01 | 0.01 |
| 21 | 7/71 | Carbunup or Marybrook | ♂ | 0+ | 310g | 41.5cm | P | 0.16 | 0.30 | 0.05 | 0.10 |
| 22 | 7/71 | Carbunup or Marybrook | ♂ | >4 | 310g | 42.0cm | P | 0.28 | 0.08 | 0.13 | 0.03 |
| 23 | 7/71 | Yallingup | ♂ | 0+ | 280g | 41.5cm | Forest | 0.03 | 0.10 | 0.01+ | 0.02 |
| 24 | 7/71 | Yallingup | ♀ | 2+ | 335g | 40.5cm | P/F | 0.04 | 0.08 | 0.03 | 0.02 |
| 25 | 7/71 | Mammoth Cave | ♀ | 2+ | 315g | 42.0cm | Forest | 0.05 | 0.02 | 0.03 | 0.01 |
| 26 | 7/71 | Mammoth Cave | ♂ | 2+ | 315g | 43.0cm | Forest | 0.08 | 0.02 | 0.04 | 0.01 |
| 27 | 7/71 | Alexandra Bridge | ♂ | >4 | 300g | 43.0cm | P/F | 0.04 | 0.03 | 0.04 | 0.02 |
| **Nannup-Mullalyup-Boyup Brook Manjimup-Pemberton** | | | | | | | | | | | |
| 28 | 7/71 | Nannup | ♀ | ≧2+ | 300g | 39.5cm | P/F | 6.82 | 3.1 | 3.4 | 1.5 |
| 29 | 7/71 | W of Bridgetown | ♀ | 1+ | 240g | 39.5cm | P | 0.03 | 0.01 | 0.04 | 0.01 |
| 30 | 7/71 | W of Bridgetown | ♀ | 4+ | 300g | 41.0cm | P | 0.10 | 0.01 | 0.05 | 0.01 |
| 31 | 7/71 | Balingup | ♂ | >4 | 305g | 40.5cm | P/F | 0.13 | 0.04 | 0.03 | 0.01 |
| 32 | 7/71 | W of Boyup Brook | ♂ | 4+ | 315g | 42.0cm | P | 0.02 | 0.14 | 0.03 | 0.03 |
| 33 | 7/71 | W of Boyup Brook | ♂ | ≧5+ | 265g | 40.5cm | P | 0.54 | 0.16 | 0.15 | 0.04 |
| 34 | 7/71 | Palgarup | ♂ | >4 | 320g | 41.0cm | Townsite | 0.13 | 0.14 | 0.04 | 0.02 |
| 35 | 7/71 | Palgarup | ♀ | 3+ | 260g | 38.0cm | Townsite | 0.06 | 0.14 | 0.02 | 0.07 |
| 36 | 7/71 | Pemberton | ♂ | 1+ | 280g | 38.0cm | Townsite | 1.25 | 0.05 | 0.27 | 0.01 |
| 37 | 7/71 | Pemberton | ♂ | >4 | 265g | 41.5cm | P/F | 0.70 | 1.00 | 0.10 | 0.10 |
| **Mt Barker-Denmark-Albany** | | | | | | | | | | | |
| 38 | 7/71 | SW of Mt Barker | ♂ | >4 | 340g | 42.0cm | P/B | 0.06 | 0.02 | 0.04 | <0.01 |
| 39 | 7/71 | SW of Mt Barker | ♂ | 1+ | 305g | 40.5cm | P/B | 0.05 | 0.20 | 0.04 | 0.01 |
| 40 | 7/71 | Mt Barker | ♂ | 1+ | 295g | 42.0cm | P/B | 0.10 | 0.04 | 0.05 | 0.01 |
| 41 | 7/71 | Albany nr Airstrip | ♂ | 2+ | 320g | 42.5cm | P | 0.08 | 0.01 | 0.06 | 0.01 |
| 42 | 7/71 | Bornholm | ♂ | >4 | 335g | 43.0cm | P | 0.20 | 0.10 | 0.05 | <0.01 |
| 43 | 7/71 | Bornholm | ♂ | >4 | 305g | 43.5cm | P/B | 0.30 | 0.10 | 0.09 | <0.01 |
| 44 | 7/71 | Kendenup | ♂ | >4 | 305g | 43.0cm | P/B | 0.40 | 0.05 | 0.20 | <0.01 |
| 45 | 7/71 | Kendenup | ♂ | >4 | 315g | 43.0cm | P/B | 0.20 | 0.02 | 0.20 | <0.01 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 119 | 2/71 | Heron Point area, Harvey Estuary | ♂ | 2+ | [335g] | 42.0cm | P | 0.02 | 0.02 | <0.01 | <<0.01 |
| | 12/70 | SE Corner, Harvey Estuary | ? | ? | ? | ? | P | 0.18 | 0.01 | 0.05+ | <<0.01 |
| | 2/71 | Mandurah district | ? | ? | ? | ? | P | 0.04 | 0.04 | 0.01+ | a [<<0.01] |
| 121 | 2/71 | Mandurah district | ♂ | 3+ | [370g] | 41.5cm | P | <0.01 | 0.01 | <0.01 | <<0.01 |
| | 12/70 | Lakeside area, Mandurah district | ? | ? | ? | ? | P | 0.02 | 0.01 | 0.02 | 0.01 |
| 3 | 7/71 | Pinjarra | ♂ | >4 | 290 | 39.5cm | P | 0.08 | 0.02 | 0.02+ | 0.01 |
| 5 | 7/71 | Waroona | ♂ | >4 | 290 | 42.0cm | P | 0.32 | 0.02 | 0.08 | 0.01 |
| 6 | 7/71 | Waroona | ♀ | 4 | 290 | 40.5cm | P | 0.04 | 0.01 | 0.01+ | <0.01 |
| 8 | 7/71 | Yarloop | ♂ | 5 | 325 | 42.5cm | P | 0.02+ | 0.01 | 0.01+ | <0.01 |
| 65 | 7/71 | Isandra (Dwellingup) | ♂ | 2+ | 300 | 39.0cm | P | 0.01 | <0.01 | 0.02 | <<0.01 |
| 66 | 7/71 | Coolup | ♂ | 1+ | 295 | 41.0cm | P/B | <0.01 | <0.01 | <<0.01 | <<0.01 |
| 71 | 7/71 | North Dandalup | ♂ | >4 | 303 | 42.5cm | P | 0.06 | 0.02 | 0.01 | <0.01 |
| 72 | 7/71 | North Dandalup | ♂ | 2+ | 305 | 43.5cm | P | 0.06 | 0.03 | 0.02 | 0.01 |
| **Waterloo-Dardanup Capel** | | | | | | | | | | | |
| 10 | 7/71 | Waterloo | ♀ | 2+ | 290 | 39.5cm | Pi | 0.06 | 0.02 | 0.02 | <0.01 |
| 11 | 7/71 | Dardanup | ♂ | <4 | 325 | 42.5cm | Pi | 0.07 | 0.03 | 0.05 | <0.01 |
| 12 | 7/71 | Dardanup | ♀ | 2+ | 310g | 39.5cm | P/b | 0.05 | 0.02 | 0.05 | 0.02 |
| 19 | 7/71 | Capel | ♂ | 2+ | 290g | 41.5cm | P | 0.01+ | 0.01 | <0.01 | <0.01 |
| 139 | 10/72 | Capel | ♂ | Adult (>4) | [360g] | 42.0cm | Townsite | 0.02 | 0.01 | 0.01 | <0.01 |
| **Donnybrook District** | | | | | | | | | | | |
| 16 | 7/71 | Lowden | ♂ | ≧5+ | 295g | 41.0cm | P | 0.41 | 0.22 | 0.16 | 0.03 |
| 17 | 7/71 | Donnybrook | ♀ | 2+ | 295g | 41.0cm | P/Orchard | 1.80 | 0.60 | 0.90 | 0.30 |
| 18 | 7/71 | 4-15 km SW of Donnybrook | ♂ | 2+ | 260g | 41.0cm | P | 0.19 | 0.10 | 0.06 | <0.01 |
| **Busselton-Augusta** | | | | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 122 | 4/73 | Scarborough | ♂ | Adult | [325g] | 42.5cm | Urban (fringe) | 0.02 | 0.01 | 0.02 | <<0.01 |
| **Orchards and Forest: Area E of Perth** | | | | | | | | | | | |
| 1 | 6/71 | Pickering Brook | ♂ | 0+ | ? | 42.0cm | Forest | 0.61 | 0.04 | 0.35 | 0.01 |
| 2 | 6/71 | Pickering Brook | ♀ | 1+ | ? | 39.5cm | Forest | 1.93 | 0.03 | 0.75 | 0.01 |
| 111 | 2/72 | Karragullen | ♂ | 0+ | 295g | 40.5cm | Orchards | 3.6 | 1.8 | 0.8 | 0.3 |
| 112 | 2/72 | Karragullen | ♂ | 1+ | 305g | 42.0cm | Orchards | 6.8 | 1.1 | 3.8 | 0.6 |
| 113 | 2/72 | Pickering Brook | ♂ | >4 yrs | 330g | 43.0cm | Orchards | 9.8 | 0.4 | 3.8 | 0.4 |
| 114 | 2/72 | Pickering Brook | ♀ | 1+ | 290g | 39.5cm | Orchards | 0.2 | 0.06 | 0.2 | 0.03 |
| 115 | 2/72 | Hacketts Gully | ♀ | 2+ | 295g | 39.5cm | Orchards | 25.0 | 0.18 | 9.0 | 0.01 |
| 116 | 2/72 | Hacketts Gully | ♂ | 1+ | 265g | 40.5cm | Orchards | 1.7 | 0.1 | 1.2 | 0.02 |
| 117 | 2/72 | Mundaring Weir | ♂ | 0+ | 295g | 43.0cm | Forest/Orchard | 0.5 | 0.1 | 0.3 | 0.01 |
| 118 | 2/72 | Pickering Brook | ♂ | >>4 yrs | 335g | 42.5cm | Orchard | 8.2 | 0.05 | 14.0 | 0.1† |
| **Armadale-Serpentine** | | | | | | | | | | | |
| 67 | 7/71 | Armadale | ♂ | 2+ | 285g | 41.5cm | Pasture | 0.1 | 0.4 | 0.04 | 0.03 |
| 68 | 7/71 | Armadale | ♀ | 2+ | 265g | 38.5cm | Pasture | 1.2 | 0.5 | 0.3 | 0.07 |
| 69 | 7/71 | Byford | ♂ | >4 | 270g | 43.0cm | P | 0.01 | 0.01 | <0.01 | <<0.01 |
| 70 | 7/71 | Byford | ♀ | 2+ | 320g | 41.5cm | P | 0.03 | 0.02 | 0.01 | <<0.01 |
| 73 | 7/71 | Serpentine | ♂ | 3+ | 308g | 38.5cm | P | 0.07 | 0.01 | 0.03 | <<0.01 |
| 110(136) | 2/72 | Serpentine | ♀ | 2+ | 260g | 37.5cm | P | 0.01 | 0.01 | 0.05 | <0.01 |
| 147 | 10/72 | Byford | ♂ | Adult | [300g] | 39.5cm | Townsite | 0.2 | 0.05 | 0.08 | 0.02 |
| **Keysbrook-Dwellingup Pinjarra-Mandurah Waroona** | | | | | | | | | | | |
| ~~X~~ | 12/70 | Greensland Rd, Pinjarra | ? | ? | ? | ? | P | 0.01 | <0.01 | <0.01 | <<0.01 |
| 120 | 2/71 | Greensland Rd, Pinjarra | ? | 0+? | [285g] | 38.5cm | P | 0.01 | 0.01 | <0.01 | <<0.01 |
| β | 12/70 | Robert Bay, Peel Inlet | ? | ? | ? | ? | P | 0.01+ | <<0.01 | <0.01 | <<0.002 |

TABLE 1

| Sample No | Date Collected | Locality | Sex | Age Class | Body Weight | Length | Habitat type | Liver DDT & metabs | Liver Dieldrin | Muscle DDT | Muscle Dieldrin |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **North of Perth** | | | | | | | | | | | |
| 75 | 8/71 | Mingenew | ♂ | 2+ | 315g | 42.0cm | Farmland | 0.01+ | 0.01 | a | a |
| 76 | 8/71 | Mingenew | ♂ | 2+ | 275g | 40.5cm | Farmland | 0.03 | 0.01 | 0.01+ | a |
| 80 | 8/71 | Mingenew | ♂ | 1+ | 275g | 42.0cm | Farmland | 0.02+ | 0.02 | a | a |
| | 12/70 | Marchagee | ? | ? | ? | ? | Farmland | 0.02+ | <0.01 | 0.01 | <0.01 |
| | 12/70 | Watheroo | ? | ? | ? | ? | Farmland | No sample | | 0.03 | 0.02 |
| | 12/70 | Guilderton | ? | ? | ? | ? | Farmland | 0.02 | 0.43 | 0.01+ | 0.11 |
| **Perth urban area** | | | | | | | | | | | |
| **Donnelly bird** | | | | | | | | | | | |
| | 12/71 | Claremont | ? | ? | ? | ? | Home Garden | 12.0 | 19.0 | 9.6 | 13.0 |
| 123 | 10/72 | Metro area | ♂ | Adult (Whiteback) | [355g] | 41.0cm | Urban | 2.0 | 1.7 | 0.4 | 0.3 |
| 126 | 10/72 | Como | ♂ | Adult [4+] | [350g] | 43.0cm | Urban | 3.2 | 1.0 | 0.9 | 0.2 |
| 129 | 10/72 | Morley | ♂ | Adult [4+] | [325g] | 40.0cm | Urban ?[fringe] | 1.2 | 1.5 | 0.4 | 0.2 |
| 134 | 10/72 | Como | ?? | ?1+ | [375g] | 44.0cm | Urban | no sample | | [4.2 | 3.2] |
| 140 | 10/72 | Willeton? | ? | 2+ | [245g] | 41.5cm | Urban | ?33.0 | 12.0 | 2.3 | 1.1 |
| 141 | 10/72 | Viveash | ♂ | Adult [3+] | [355g] | 40.7cm | Urban fringe | 1.7 | 0.2 | 0.4 | 0.1 |
| 143 | 10/72 | Viveash | ♂ | 1+ | [340g] | 39.5cm | Urban fringe | 1.7 | 0.2 | 0.3 | 0.03 |
| 142 | 10/72 | Metro area | ♂ | Adult | [340g] | 38.0cm | ?Urban fringe | 0.5 | 0.5 | 0.3 | 0.2 |
| 144 | 10/72 | North Beach | ♂ | Adult | [330g] | 39.0cm | Urban | 3.8 | 2.2 | 1.2 | 0.3 |
| 145 | 10/72 | Morley | ♂ | Adult | [375g] | 42.0cm | Urban fringe | 0.6 | 0.2 | 0.4 | 0.1 |
| 146 | 10/72 | Balga | ♂ | Adult | [335g] | 43.5cm | Urban fringe | 0.5 | 0.3 | 0.4 | 0.1 |
| 125 | 11/72 | Metro area | ♀ | 2+ | [355g] | 40.0cm | Urban | 3.4 | 3.4 | 0.4 | 0.5 |
| 128 | 11/72 | Cloverdale | ♂ | 1+ | [285g] | 37.0cm | Urban | 1.7 | 1.7 | 0.4 | 0.4 |

# AVIAN AND MAMMALIAN WILDLIFE TOXICOLOGY: SECOND CONFERENCE

A symposium
sponsored by ASTM
Committee E-35 on
Pesticides
AMERICAN SOCIETY FOR
TESTING AND MATERIALS
Louisville, Ky.
18 March 1980

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AMERICAN SOCIETY FOR TESTING AND MATERIALS
1916 Race Street, Philadelphia, Pa. 19103

R. I. L. PRINCE

# THE USE AND SIGNIFICANCE OF PESTICIDES IN THE ENVIRONMENT

F. L. McEWEN

G. R. STEPHENSON

University of Guelph
Guelph, Ontario, Canada



A WILEY-INTERSCIENCE PUBLICATION
JOHN WILEY & SONS, New York • Chichester • Brisbane • Toronto

Total DDT metabolites.

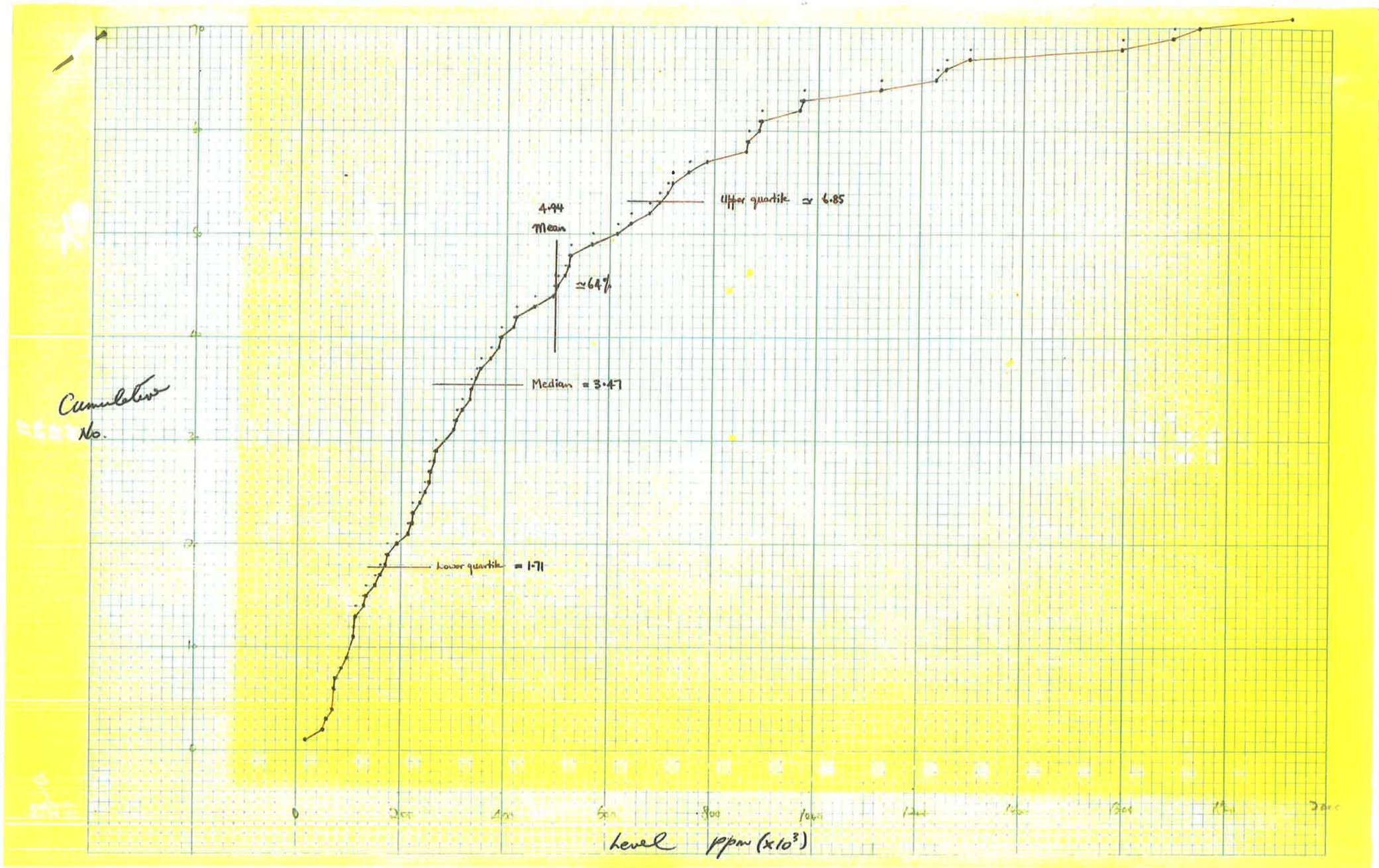



ppm DDT+ Metabs
Pectoral Muscle

| | ♂♂s | ♀♀s |
|---|---|---|
| 1st m | 21, 23, | 20, |
| 2nd m | (9) 36, 39, 40, 46, 48, 52, 54, 60, 66, | 29, 47, |
| 3rd M | (10) 18, 19, 26, 41, 51, 62, 64, 65, 67, 72 | (9) 10, 12, 17, 24, 25, 56, 57, 68, 70 |
| 4th → | 73 | 28 |
| 1st yr | 1, | |
| 2nd yr | | 2, |
| 3rd yr | 61 | 35 |
| 4th | 32 | 6, 30 |
| 4+ → | (22) 3, 5, 11, 13, 14, 15, 22, 27, 31, 34, 37, 38, 42, 43, 44, 45, 49, 50, 53, 55, 69, 71<br>8 | |
| 5 and > 5 | (5) 16, 33, ~~58~~ (4 boys), 59, 63, | |
| | 53 ♂♂s | 17 ♀♀s |

21
17

Age Classes


Cumulative No.
4.94
Mean
≃64%
Upper quartile ≃ 6.85
Median = 3·47
Lower quartile = 1·71
Level ppm (x10³)

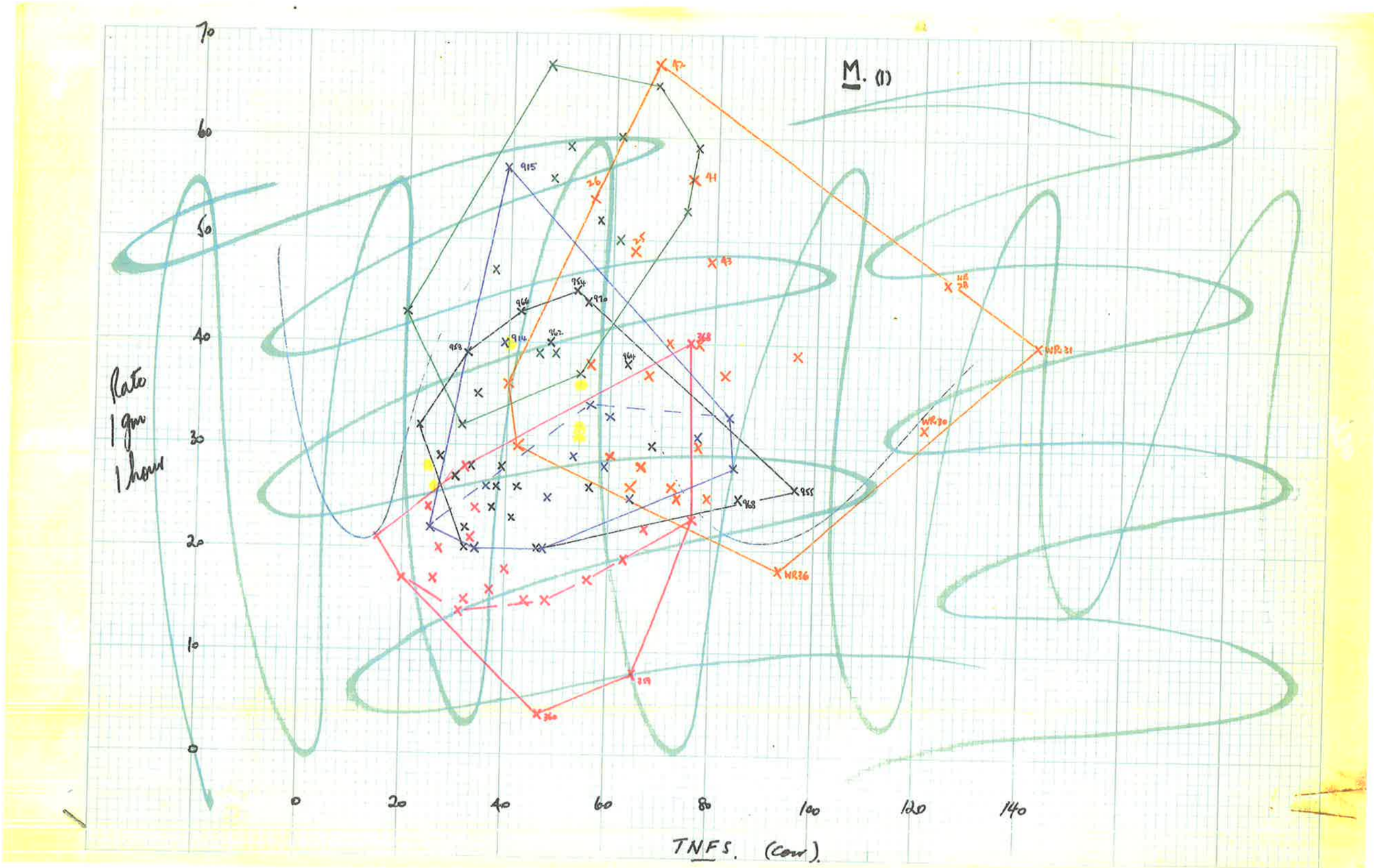
18
58 50
61
70 (2)
72

18
50
58
69
70 (2)
72
85
98
108 (2)
112 (2)
126
132
151
160
169
171
193
214
220
221
237
244
250
253
262
263
300 (2)
303
315
330
332
342
352
372
386
(40) - 391
416
420
455
493
514 ← 500
520
521
566
615
640
675
695
709
720

754
785
861
865
(60) - 885
890
968
970
1122
1230
1246
1293
1590
1690
1740
71 — 1962

63.4
71)450
426
240
213
270
284

64.8
240
284
560


M. (1)
Rate
1 gm
1 hour
70
60
50
40
30
20
10
0
0
20
40
60
80
100
120
140
TNFS. (Cow).
915
954
966
970
914
962
963
964
955
958
WR 38
WR 31
WR 30
WR 36
368
42
41
26
25
43
39
36

SCHOOL/
DEPT. ZOOLOGY / DAWSON

THE UNIVERSITY OF NEW SOUTH WALES
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POSTAGE
PAID
AUSTRALIA

Analysts Reports

DR. R.I.T. PRINCE
DEPT. OF CONSERVATION & LAND
MANAGEMENT,
OCEAN REEF ROAD,
WOODVALE WA 6065.

Residues, Pesticides.

copied to Peter Rutherford

1/7/87

Peter Rutherford

Analyst reports plus
unpublished report Summ.
M. JAK LANE - ORD RIVER
AREA.

1/7/89

(Report is in JAKA file)

Duplicate

Department of Mines, Western Australia

**GOVERNMENT CHEMICAL LABORATORIES**

30 Plain St., Perth, Western Australia, 6000. Tel. 25 5544

Address all correspondence to the Director.

Correspondents should confine each letter to one subject. Write on one side of the paper only.

The Director,
Department of Fisheries and Fauna,
108 Adelaide Terrace,
PERTH. W.A. 6000

9th November, 1973 JB

Attention, Mr. J. Lane

OUR REF:

YOUR REF: 187/71

MATERIAL: One hundred and two samples of bird tissue as below from the Ord River area.

LAB. No. 18540-641/73

FROM WHOM RECEIVED AND DATE: Department of Fisheries and Fauna on 19.10.73

~~RESULT OF EXAMINATION~~

Description of samples: The bird tissue samples were collected from the Ord River area during May 1973. All tissues were taken from Magpie Larks with the exception of:-

| | | |
|---|---|---|
| 73/OR/5, 73/OR/6, 73/OR/7 | : | Black-faced Wood Swallows |
| 73/OR/8 | : | Boobook Owl |
| 73/OR/9, 73/OR/17, 73/OR/82 | : | Spotted Nightjar |
| 73/OR/23, 73/OR/79 | : | Brown Hawk |
| 73/OR/27 | : | White Egret |
| 73/OR/63, 73/OR/72 | : | Whistling Eagle |

The Magpie Larks were collected in the irrigation area and at varying distances up to 40 miles upwind and downwind of the Ivanhoe Plains.

The letters M, L, F, SC and B after each sample number refer to muscle, liver, fat, stomach contents and brain tissue respectively.

2/...

Result of examination:

| Sample No. | Lab. No. | DDT & metabolites parts per million |
|---|---|---|
| 73/OR/1M | 18540 | 0.1 |
| 73/OR/2M | 18541 | 0.6 |
| 73/OR/3M | 18542 | 0.2 |
| 73/OR/4M | 18543 | 1.1 |
| 73/OR/5M | 18544 | 4.8 |
| 73/OR/5L | 18545 | 34 |
| 73/OR/5,6,7F | 18546 | 180 |
| 73/OR/6M | 18547 | 6 |
| 73/OR/7M | 18548 | 3 |
| 73/OR/7L | 18549 | 22 |
| 73/OR/9M | 18550 | 0.5 |
| 73/OR/9L | 18551 | 0.3 |
| 73/OR/9SC | 18552 | 8 |
| 73/OR/10M | 18553 | 0.4 |
| 73/OR/11M | 18554 | 0.3 |
| 73/OR/12M | 18555 | 1.8 |
| 73/OR/13M | 18556 | 13 |
| 73/OR/14M | 18557 | 0.9 |
| 73/OR/15M | 18558 | 0.6 |
| 73/OR/16M | 18559 | 2.4 |
| 73/OR/17M | 18560 | 2.9 |
| 73/OR/17L | 18561 | 2.3 |
| 73/OR/17SC | 18562 | 2.8 |
| 73/OR/18M | 18563 | 7 |
| 73/OR/19M | 18564 | 13 |
| 73/OR/20M | 18565 | 1.3 |
| 73/OR/21M | 18566 | 2.4 |
| 73/OR/22M | 18567 | 3.9 |
| 73/OR/23M | 18568 | 0.6 |
| 73/OR/23L | 18569 | 0.3 |
| 73/OR/23F | 18570 | 24 |
| 73/OR/23SC | 18571 | 4.4 |
| 73/OR/23B | 18572 | 0.1 |
| 73/OR/24M | 18573 | 5.4 |
| 73/OR/25M | 18574 | 0.4 |
| 73/OR/26M | 18575 | 3.7 |
| 73/OR/27M | 18576 | 2.9 |

3/...

| Sample No. | Lab. No. | DDT & metabolites parts per million | |
|---|---|---|---|
| 73/OR/27L | 18577 | 1.6 | White Tegmet |
| 73/OR/28M | 18578 | 1.1 | not included |
| 73/OR/29M | 18579 | n.d. | 21 m SE |
| 73/OR/30M | 18580 | 0.1 | 19 m SE |
| 73/OR/31M | 18581 | 0.2 | 23 m SE |
| 73/OR/32M | 18582 | 0.9 | 3m NW |
| 73/OR/33M | 18583 | 0.8 | |
| 73/OR/34M | 18584 | 0.3 | Carlton Ave |
| 73/OR/35M | 18585 | 0.1 | x: 0.33 |
| 73/OR/36M | 18586 | 0.4 | |
| 73/OR/37M | 18587 | 0.06 | 19 m SE |
| 73/OR/38M | 18588 | n.d. | ? |
| 73/OR/39M | 18589 | n.d. | 38 m SE |
| 73/OR/40M | 18590 | 0.09 | 4 m NW |
| 73/OR/41M | 18591 | 2.3 | 3m NW |
| 73/OR/42M | 18592 | 0.08 | |
| 73/OR/43M | 18593 | 0.06 | |
| 73/OR/44M | 18594 | 0.07 | 15 m NW |
| 73/OR/45M | 18595 | 0.1 | x = 0.10 (0.05 - 0.20) |
| 73/OR/46M | 18596 | 0.2 | |
| 73/OR/47M | 18597 | 0.04 | |
| 73/OR/48M | 18598 | 0.05 | 25 m NW |
| 73/OR/49M | 18599 | 0.04 | x = 0.05 (0.03 - 0.07) |
| 73/OR/50M | 18600 | 0.04 | 19 m SE |
| 73/OR/51M | 18601 | 0.06 | 30 m SE |
| 73/OR/52M | 18602 | n.d. | 38 m SE |
| 73/OR/53M | 18603 | 0.7 | 3 m NW |
| 73/OR/54M | 18604 | 0.07 | 25 m NW |
| 73/OR/55M | 18605 | n.d. | |
| 73/OR/55F | 18606 | 0.2 | 35 m NW |
| 73/OR/56M | 18607 | 0.08 | |
| 73/OR/57M | 18608 | 0.02 | x: 0.03 (n.d - 0.08) |
| 73/OR/58M | 18609 | 0.02 | |
| 73/OR/59M | 18610 | 0.02 | |
| 73/OR/60M | 18611 | 0.03 | 25 m NW |
| 73/OR/61M | 18612 | 0.03 | Carlton Ave |
| 73/OR/62M | 18613 | 1 | irrigation ditch |
| 73/OR/63M | 18614 | 0.4 | Winding Eagle |

4/...

| Sample No. | Lab. No. | DDT & metabolites parts per million | |
|---|---|---|---|
| 73/OR/63L | 18615 | 0.5 | Winding Eagle |
| 73/OR/63F | 18616 | 13 | |
| 73/OR/63B | 18617 | 0.08 | |
| 73/OR/64M | 18618 | 0.01 | 42 m SE |
| 73/OR/65M | 18619 | 0.01 | 38 m SE |
| 73/OR/66M | 18620 | 0.2 | 3 m NW |
| 73/OR/67M | 18621 | 1.1 | |
| 73/OR/68M | 18622 | 0.03 | Sandy Loam? |
| 73/OR/69M | 18623 | 1.2 | SCE 1.09 |
| 73/OR/70M | 18624 | 2.1 | |
| 73/OR/71M | 18625 | 1 | |
| 73/OR/72M | 18626 | 5.3 | |
| 73/OR/72L | 18627 | 3.8 | Winding Eagle |
| 73/OR/72F | 18628 | 170 | |
| 73/OR/72B | 18629 | 5.9 | |
| 73/OR/73M | 18630 | 0.1 | 33 m downstream |
| 73/OR/78M | 18631 | 0.02 | 35 m SE ✓ |
| 73/OR/79M | 18632 | 0.02 | |
| 73/OR/79L | 18633 | 0.02 | Crown Feature ✓ |
| 73/OR/79F | 18634 | 0.4 | |
| 73/OR/79SC | 18635 | n.d. | |
| 73/OR/80M | 18636 | 0.01 | 43 m SE ✓ |
| 73/OR/81M | 18637 | 0.06 | 32 m SE ✓ |
| 73/OR/82M | 18638 | 2.7 | |
| 73/OR/82L | 18639 | 0.1 | Special Feature ✓ |
| 73/OR/82F | 18640 | 200 | |
| 73/OR/82SC | 18641 | 3.7 | |

n.d. = not detected. Limit of detection for DDT and metabolites was 0.01 parts per million.

No other common organochlorine pesticides were detected in the samples.

G.F. EBELL
A.T. WILKIE
CHEMISTS & RESEARCH OFFICERS

N.R. HOUGHTON
CHIEF OF DIVISION
FOOD, DRUGS & TOXICOLOGY

Department of Mines, Western Australia

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30 Plain St., Perth, Western Australia, 6000. Tel. 25 5544

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Director
Department of Fisheries & Fauna
108 Adelaide Tce
Perth
W.A.....6000

August 22, 1973 MCG

Attention: Mr. J. Lane

OUR REF:

YOUR REF: 187/71

MATERIAL: Nineteen samples of bird tissue as below from the Ord Irrigation Area, in connection with death of Black Kites (Milvus migrans).

LAB. No. 10869-887/73

FROM WHOM RECEIVED AND DATE: Dept of Fisheries and Fauna on 12.6.73

RESULT OF EXAMINATION:

| Sample | Tissue | Lab.No. (1973) | DDT and metabolites | Parathion | Toxaphene |
|---|---|---|---|---|---|
| | | | parts per million | | |
| 730R74B | Brain | 10869 | 0.4 | a | b |
| 730R74SC | Stomach contents | 10870 | 7.7 | 3.6 | 10 |
| 730R74M | Muscle | 10871 | 1.9 | a | b |
| 730R74L | Liver | 10872 | 0.4 | a | b |
| 730R74F | Fat | 10873 | 40 | a | 30 |
| 740R75B | Brain | 10874 | 0.1 | a | b |
| 730R75SC | Stomach contents | 10875 | 3.8 | 2.3 | 7.5 |
| 730R75M | Muscle | 10876 | 0.14 | a | b |
| 730R75L | Liver | 10877 | 0.06 | a | b |
| 730R75F | Fat | 10878 | 8.4 | a | 6 |
| 730R76B | Brain | 10879 | 0.3 | a | b |
| 730R76SC | Stomach contents | 10880 | 4.0 | 3.2 | 7.5 |
| 730R76M | Muscle | 10881 | 0.24 | a | b |
| 730R76L | Liver | 10882 | 0.8 | a | b |
| 730R77B | Brain | 10883 | 0.14 | a | b |
| 730R77SC | Stomach contents | 10884 | 3.8 | 1.4 | 5 |
| 730R77M | Muscle | 10885 | 0.5 | a | b |
| 730R77L | Liver | 10886 | 0.2 | a | b |
| 730R77F | Fat | 10887 | 7.8 | 0.4 | 5.5 |

a = not detected (Limit of detection, 0.01 ppm)
b = less than 0.2 ppm

Subsequent to receiving these Fauna samples and your letter of 11 June, advice was received requesting priority for Fisheries samples received on 14 June (our reports of 24 July and 8 August, Lab.Nos.11110-11177/73)

The above Fauna samples were therefore held in "deep freeze" at approximately -15°C, prior to being analysed.

N.R.HOUGHTON
CHIEF OF DIVISION
FOOD, DRUGS & TOXICOLOGY

A.T.WILKIE
CHEMIST & RESEARCH OFFICER

| mple No | Lab.No. (1972) | Tissue | DDT + Metabolites | Dieldrin |
|---|---|---|---|---|
| | | | parts per million | |
| 40A | 17556 | Muscle | 0.3 | less than 0.01 |
| 40B | 17557 | Liver | 0.3 | " " 0.07 |
| 40C | 17558 | Fat | 6.0 | " " 0.1 |
| 41A | 17559 | Muscle | 0.8 | " " 0.02 |
| 41B | 17560 | Liver | 3.0 | " " 0.1 |
| 42A | 17561 | Muscle | 0.01 | " " 0.01 |
| 42B | 17562 | Liver | 0.05 | " " 0.01 |
| 43A | 17563 | Muscle | 1.8 | " " 0.03 |
| 43B | 17564 | Liver | 5.5 | " " 0.05 |
| 44A | 17565 | Muscle | 4.0 | " " 0.06 |
| 44B | 17566 | Liver | 12.0 | " " 0.1 |
| 45A | 17567 | Muscle | 14.0 | " " 0.1 |
| 45B | 17568 | Liver | 9.5 | " " 0.08 |
| 46A | 17569 | Liver | 0.01 | " " 0.01 |
| 46B | 17570 | Muscle | 0.03 | " " 0.01 |
| 46C | 17571 | Fat | 0.2 | " " 0.03 |
| 47A | 17572 | Muscle | 0.2 | " " 0.01 |
| 47B | 17573 | Liver | 1.6 | " " 0.02 |
| 48A | 17574 | Muscle | 0.05 | " " 0.01 |
| 48B | 17575 | Liver | 0.1 | " " 0.01 |
| 49A | 17576 | Muscle | 7.0 | " " 0.06 |
| 49B | 17577 | Liver | 1.0 | " " 0.06 |
| 49C | 17578 | Fat | 250 | " " 1 |
| 49D | 17579 | Stomach Contents | 3.5 | " " 0.06 |
| 49E | 5397/73 | Brain | 0.8 | " " 0.03 |
| 50 | 5398/73 | Fairy Martin | 19 | " " 0.3 |

Note: Variations in "less than" figures for dieldrin were due to size of sample and amount of DDT + metabolites detected.

No other common organo-chlorine insecticides were detected.

G.F.EBELL
J.M.CHALLINOR
CHEMISTS & RESEARCH OFFICERS

N.R.HOUGHTON
CHIEF OF DIVISION
FOOD, DRUGS & TOXICOLOGY

| Sample No | Lab.No. (1972) | Tissue | | DDT + Metabolites | Dieldrin |
|---|---|---|---|---|---|
| | | | | parts per million | |
| 15A | 17498 | Muscle | Black-faced Wood Swallow | 0.8 | less than 0.03 |
| 16A | 17499 | Muscle | | 0.4 | " " 0.01 |
| 16B | 17500 | Liver | White Faced | 0.5 | 0.02 |
| 17A | 17501 | Muscle | Magpie Lark | 0.1 | 0.04 |
| 17B | 17502 | Liver | | 0.3 | 0.2 |
| 18A | 17503 | Muscle | Magpie Lark | 0.4 | 0.1 |
| 18B | 17504 | Liver | | 0.5 | 0.1 |
| 19A | 17505 | Muscle | Red-backed Kingfisher | 0.1 | less than 0.01 |
| 19B | 17506 | Liver | | 0.4 | 0.2 |
| 20A | 17507 | Muscle | Black-faced Cuckoo Shrike | 0.2 | less than 0.01 |
| 20B | 17508 | Liver | | 0.3 | 0.01 |
| 21A | 17509 | Muscle | | 0.05 | 0.01 |
| 21B | 17510 | Liver | " " | 0.3 | 0.2 |
| 22A | 17511 | Muscle | American Pectinicle | 5.3 | less than 0.02 |
| 22B | 17512 | Liver | | 5.3 | " " 0.01 |
| 23A | 17513 | Muscle | Masked Knight | 8.0 | " " 0.02 |
| 23B | 17514 | Liver | | 2.2 | " " 0.02 |
| 23C | 17515 | Fat | | 300 | " " 2 |
| 24A | 17516 | Muscle | Red-backed kingfisher | 2.5 | " " 0.01 |
| 24B | 17517 | Liver | | 5.0 | " " 0.1 |
| 25A | 17518 | Muscle | Brown Falcon | 4.5 | " " 0.1 |
| 25B | 17519 | Liver | | 1.0 | " " 0.001 |
| 25C | 17520 | Fat | | 120 | " " 2 |
| 26A | 17521 | Muscle | Red-tailed Black Cockatoo | 0.3 | " " 0.01 |
| 26B | 17522 | Liver | | 0.05 | " " 0.01 |
| 26C | 17523 | Fat | | 12 | " " 0.1 |
| 27A | 17524 | Muscle | | 0.2 | " " 0.01 |
| 27B | 17525 | Liver | | 0.3 | " " 0.01 |
| 27C | 17526 | Fat | | 6.0 | " " 0.5 |
| 28A | 17527 | Muscle | White Ibis | 1.1 | " " 0.01 |
| 28B | 17528 | Liver | | 0.9 | " " 0.01 |
| 29A | 17529 | Muscle | White Faced | 3.3 | " " 0.01 |
| 29B | 17530 | Liver | | 0.6 | " " 0.01 |
| 30A | 17531 | Muscle | Brown Falcon | 3.5 | " " 0.03 |
| 30B | 17532 | Liver | | 0.6 | " " 0.01 |
| 30C | 17533 | Fat | | 220 | " " 5 |
| 31A | 17534 | Muscle | Crested | 0.3 | " " 0.01 |
| 31B | 17535 | Liver | | 0.4 | " " 0.01 |
| 32A | 17536 | Muscle | Crested | 0.4 | " " 0.01 |
| 32B | 17537 | Liver | | 0.4 | " " 0.01 |
| 33A | 17538 | Muscle | Crested | 0.2 | " " 0.01 |
| 33B | 17539 | Liver | | 0.04 | " " 0.01 |
| 34A | 17540 | Muscle | Crested | 0.4 | " " 0.01 |
| 34B | 17541 | Liver | | 0.2 | " " 0.01 |
| 35A | 17542 | Muscle | Long-nosed Bandicoot | 0.2 | " " 0.04 |
| 36A | 17543 | Muscle | | 6.5 | 0.5 |
| 36B | 17544 | Liver | Brown Hawk | 3.0 | 1.0 |
| 36C | 17545 | Fat | | 220 | less than 0.03 |
| 37A | 17546 | Muscle | | 2.0 | 0.02 |
| 37B | 17547 | Liver | Black Kite | 0.2 | Less than 1 |
| 37C | 17548 | Fat | | 40 | 0.02 |
| 38A | 17549 | Muscle | White Tailed Cormorant | 0.3 | 0.02 |
| 38B | 17550 | Liver | | 0.3 | 0.04 |
| 38D | 17551 | Stomach | Contents | 0.2 | less than 0.01 |
| 39A | 17552 | Muscle | | 0.3 | " " 0.01 |
| 39B | 17553 | Liver | Brown Falcon | 0.3 | " " 1 |
| 39C | 17554 | Fat | | 22 | " " 0.01 |
| 39D | 17555 | Stomach | Contents | 0.1 | |

Department of Mines, Western Australia

**GOVERNMENT CHEMICAL LABORATORIES**

30 Plain St., Perth, Western Australia, 6000. Tel. 25 5544

Address all correspondence to the Director.

Correspondents should confine each letter to one subject. Write on one side of the paper only.

Director
Department of Fisheries & Fauna
108 Adelaide Tce
Perth
W.A....6000

20th March 1973 MCG

Attention: Mr. J. Lane

OUR REF:

YOUR REF: 187/71

MATERIAL: One hundred and fifteen samples of bird tissue as below.

LAB. No. 17467-579/72, 5397-98/73

FROM WHOM RECEIVED AND DATE: Dept. of Fisheries and Fauna on 18.8.72

RESULT OF EXAMINATION:

| Sample No. | Lab.No. (1972) | Tissue | | DDT + Metabolites parts per million | Dieldrin parts per million |
|---|---|---|---|---|---|
| 1A | 17467 | Liver | Little Grebe | 6.1 | less than 0.05 |
| 1B | 17468 | Muscle | | 3.6 | " " 0.05 |
| 2A | 17469 | Muscle | Diamond Dove | 1.0 | " " 0.05 |
| 3A | 17470 | Muscle | Rainbow Bird | 3.0 | " " 0.05 |
| 4A | 17471 | Muscle | Rainbow Bird | 2.6 | " " 0.04 |
| 5A | 17472 | Muscle | Brown Falcon | 0.8 | " " 0.05 |
| 5B | 17473 | Liver | | 1.6 | " " 0.5 |
| 5C | 17474 | Fat | | 120 | " " 0.2 |
| 6A | 17475 | Muscle | | 18 | " " 0.05 |
| 6B | 17476 | Liver | Brown Falcon | 2.9 | " " 0.5 |
| 6C | 17477 | Fat | | 58 | " " 1 |
| 6D | 17478 | Stomach Contents | | 29 | " " 0.05 |
| 7A | 17479 | Muscle | | 3.2 | " " 0.05 |
| 7B | 17480 | Liver | Little Falcon | 1.6 | " " 5 |
| 7C | 17481 | Fat | | 70 | " " 0.01 |
| 8A | 17482 | Muscle | | 0.3 | " " 0.01 |
| 8B | 17483 | Liver | Little Corella | 0.4 | " " 0.02 |
| 8C | 17484 | Fat | | 12 | " " 0.01 |
| 9A | 17485 | Muscle | Little Corella | 0.1 | " " 0.01 |
| 9B | 17486 | Liver | | 0.05 | " " 0.01 |
| 10A | 17487 | Muscle | | 0.3 | " " 0.01 |
| 10B | 17488 | Liver | Brown Falcon | 0.1 | " " 0.04 |
| 10C | 17489 | Fat | | 7.6 | " " 0.02 |
| 11A | 17490 | Muscle | Blue-winged Butcher Bird | 0.3 | " " 0.01 |
| 12A | 17491 | Muscle | | 0.1 | " " 0.01 |
| 12B | 17492 | Liver | Brown Falcon | 0.03 | " " 0.01 |
| 13A | 17493 | Muscle | | 0.1 | " " 0.01 |
| 13B | 17494 | Liver | Brown Falcon | 0.1 | " " 0.3 |
| 13C | 17495 | Fat | | 12 | " " 0.01 |
| 14A | 17496 | Muscle | Red-backed Kingfisher | 0.4 | 0.02 |
| 14B | 17497 | Liver | | 0.4 | |

Mr. Lane, Reserve Management

Peter Rutherford

Egg samples - analysis reports

11/7/87

Department of Mines, Western Australia

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Director
Department of Fisheries & Fauna
108 Adelaide Tce,
Perth
W.A. 6000

Attention: Mr. J. Lane

14th August 1974 MCG

OUR REF:

YOUR REF: 187/71

MATERIAL: Twenty eight samples of eggs, marked below.

LAB No. 15826-53/74

FROM WHOM RECEIVED AND DATE: Dept of Fisheries & Fauna on 19.7.74.

RESULT OF EXAMINATION:

| Sample | Lab.No. | Lipids per cent | DDD | DDE | DDT | Dieldrin |
|---|---|---|---|---|---|---|
| | | | parts per million as received | | | |
| **Pelican Port Hedland** | | | | | | |
| 48 | 15826 | 4.1 | 0.01 | 0.08 | n.d | 0.03 |
| 49 | 15827 | 3.5 | 0.02 | 0.04 | 0.009 | 0.03 |
| 50 | 15828 | 4.7 | 0.009 | 0.03 | 0.005 | 0.02 |
| **Pelican Derby** | | | | | | |
| 51 | 15829 | 4.2 | 0.25 | 0.35 | n.d | 0.09 |
| 52 | 15830 | 3.6 | n.d | 0.003 | n.d | 0.005 |
| 53 | 15831 | 3.9 | 0.003 | 0.02 | 0.007 | 0.007 |
| 54 | 15832 | 4.0 | 0.05 | 0.08 | n.d | 0.02 |
| 55 | 15833 | 4.9 | 0.002 | 0.007 | n.d | 0.006 |
| **Whistling eagle Lake Argyle** | | | | | | |
| 1 | 15834 | 5.0 | 0.002 | 0.01 | 0.005 | n.d |
| 2 | 15835 | 4.8 | 0.08 | 1.4 | 0.14 | n.d |
| **Darter Lake Argyle** | | | | | | |
| 1 | 15836 | 6.1 | n.d | 0.04 | n.d | n.d |
| 2 | 15837 | 3.6 | n.d | 0.03 | n.d | n.d |
| 5 | 15838 | 2.9 | n.d | 0.07 | 0.01 | 0.04 |
| 6 | 15839 | 4.6 | n.d | 0.04 | n.d | n.d |
| 7 | 15840 | 5.9 | 0.007 | 0.07 | 0.08 | n.d |
| 8 | 15841 | 5.0 | 0.006 | 0.05 | 0.06 | n.d |

2/-

| Sample | Lab.No. | Lipids per cent | DDD | DDE | DDT | Dieldrin |
|---|---|---|---|---|---|---|
| | | | parts per million as received | | | |
| Little Pied Cormorants Lake Argyle | | | | | | |
| 2 | 15842 | 5.8 | n.d | 0.25 | 0.03 | n.d |
| 7 | 15843 | 3.2 | n.d | 0.10 | n.d | n.d |
| 8 | 15844 | 5.1 | n.d | 0.20 | 0.03 | n.d |
| 9 | 15845 | 3.0 | n.d | 0.10 | n.d | n.d |
| 10 | 15846 | 5.1 | n.d | 0.27 | 0.03 | n.d |
| 11 | 15847 | 5.6 | n.d | 0.14 | n.d | n.d |
| 15 | 15848 | 5.3 | n.d | 0.18 | 0.03 | n.d |
| 19 | 15849 | 5.3 | n.d | 0.28 | n.d | n.d |
| 20 | 15850 | 4.8 | n.d | 0.24 | 0.02 | n.d |
| 22 | 15851 | 5.9 | n.d | 0.37 | 0.09 | n.d |
| 23 | 15852 | 5.4 | n.d | 0.03 | 0.003 | n.d |
| Osprey Dorre Island | | | | | | |
| 2 | 15853 | 2.1 | 0.07 | 0.70 | 0.10 | n.d |

n.d. = not detected

Limits of detection for DDD, DDT and Dieldrin were 0.002, 0.003 and 0.002 parts per million respectively.

A.T.WILKIE
B.F.LYNCH
CHEMIST & RESEARCH OFFICERS

N.R.HOUGHTON
CHIEF OF DIVISON
FOOD, DRUGS & TOXICOLOGY

DUPLICATE

Department of Mines, Western Australia

**GOVERNMENT CHEMICAL LABORATORIES**

30 Plain St., Perth, Western Australia, 6000. Tel. 25 5544

Address all correspondence to the Director.

Correspondents should confine each letter to one subject. Write on one side of the paper only.

Director,
Department of Fisheries and Fauna,
Wildlife Research Centre,
P.O. Box 51,
WANNEROO 6065.

13 June 1974 SAK

OUR REF: Attention: Mr. J. Lane

YOUR REF: 187/71

MATERIAL: Eleven samples of eggs (1 Osprey egg from Dampier 10 Pelican eggs from Sharks Bay), as below.

LAB. No: 10471-81/74

FROM WHOM RECEIVED AND DATE: Department of Fisheries and Fauna on 24 May 1974

RESULT OF EXAMINATION:

| Marks | Lab. No. | DDE | DDT | Dieldrin | Lipid per cent w/w |
|---|---|---|---|---|---|
| | | parts per million as received | | | |
| Osprey Egg No. 1 | 10471 | 0.02 | n.d. | n.d. | 3.9 |
| Pelican Egg No. 38 | 10472 | 0.01 | n.d. | n.d. | 6.0 |
| Pelican Egg No. 39 | 10473 | 0.01 | n.d. | n.d. | 5.9 |
| Pelican Egg No. 40 | 10474 | 0.02 | 0.01 | 0.02 | 5.3 |
| Pelican Egg No. 41 | 10475 | 0.01 | n.d. | 0.004 | 4.9 |
| Pelican Egg No. 42 | 10476 | 0.01 | n.d. | 0.005 | 5.5 |
| Pelican Egg No. 43 | 10477 | 0.01 | n.d. | n.d. | 5.9 |
| Pelican Egg No. 44 | 10478 | 0.01 | 0.004 | n.d. | 6.3 |
| Pelican Egg No. 45 | 10479 | 0.003 | 0.003 | n.d. | 6.5 |
| Pelican Egg No. 46 | 10480 | 0.01 | n.d. | n.d. | 7.3 |
| Pelican Egg No. 47 | 10481 | 0.004 | n.d. | n.d. | 6.2 |

n.d. not detected. Limits of detection for DDT and Dieldrin were 0.002 parts per million.

No other common organo-chlorine pesticides were detected in the samples.

J.M. CHALLINOR
CHEMIST AND RESEARCH OFFICER

W.R. Wood

W.R. WOOD
ACTING CHIEF OF DIVISION
FOOD, DRUGS AND TOXICOLOGY

Department of Mines, Western Australia

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Address all correspondence to the Director.

Correspondents should confine each letter to one subject. Write on one side of the paper only.

Director
Department of Fisheries & Fauna
108 Adelaide Tce
Perth
W.A.....6000

September 21, 1973 MCG

OUR REF: Attention: Mr. J.Lane

YOUR REF: 187/71

MATERIAL: Twenty two samples of pelican eggs from Peel Inlet.

LAB. No. 16303-24/73

FROM WHOM RECEIVED AND DATE: Dept of Fisheries & Fauna on 7.9.73

RESULT OF EXAMINATION:

| Lab.No. | Marks | | DDD | DDE | DDT | Dieldrin | Lipid per cent |
|---|---|---|---|---|---|---|---|
| | | | ——— parts per million——— | | | | |
| | | | - - - - - - - -as received- - - - - - - - | | | | |
| 16303 | 16 | 0.10 | 0.01 | 0.07 | 0.02 | 0.1 | 6.0 |
| 16304 | 17 | 0.62 | 0.2 | 0.4 | 0.02 | 0.1 | 6.5 |
| 16305 | 18 | 0.04 | 0.01 | 0.02 | 0.01 | 0.05 | 6.2 |
| 16306 | 19 | 0.14 | 0.08 | 0.1 | 0.01 | 0.07 | 6.4 |
| 16307 | 20 | 0.10 | 0.02 | 0.05 | 0.03 | 0.2 | 6.0 |
| 16308 | 21 | 0.03 | 0.03 | 0.6 | 0.1 | 0.05 | 7.1 |
| 16309 | 22 | 0.05 | 0.01 | 0.02 | 0.02 | 0.07 | 6.8 |
| 16310 | 23 | 0.71 | 0.05 | 0.6 | 0.06 | 0.05 | 6.5 |
| 16311 | 24 | 0.07 | 0.01 | 0.04 | 0.02 | 0.08 | 6.5 |
| 16312 | 25 | 0.04 | 0.01 | 0.01 | 0.02 | 0.09 | 5.7 |
| 16313 | 26 | 0.06 | 0.01 | 0.02 | 0.01 | 0.07 | 6.2 |
| 16314 | 27 | 0.01 | 0.01 | 0.03 | 0.02 | 0.1 | 5.9 |
| 16315 | 28 | 0.02 | 0.01 | 0.01 | 0.01 | 0.07 | 5.2 |
| 16316 | 29 | 0.03 | 0.01 | 0.01 | 0.01 | 0.04 | 4.9 |
| 16317 | 30 | 0.02 | 0.01 | 0.01 | 0.01 | 0.04 | 5.9 |
| 16318 | 31 | 0.05 | 0.01 | 0.02 | 0.02 | 0.09 | 6.7 |
| 16319 | 32 | 0.07 | 0.01 | 0.01 | 0.01 | 0.06 | 7.0 |
| 16320 | 33 | 0.03 | 0.01 | 0.01 | 0.01 | 0.02 | 6.5 |
| 16321 | 34 | 0.03 | 0.01 | 0.01 | 0.01 | 0.06 | 6.3 |
| 16322 | 35 | 0.15 | 0.02 | 0.05 | 0.03 | 0.2 | 5.6 |
| 16323 | 36 | 0.03 | 0.01 | 0.01 | 0.01 | 0.02 | 6.5 |
| 16324 | 37 | 0.05 | 0.01 | 0.02 | 0.02 | 0.06 | 6.8 |

0.01 - 0.6

No other common organochlorine pesticides were detected in the samples.

N.R.HOUGHTON
CHIEF OF DIVISION
FOOD, DRUGS & TOXICOLOGY

A.T.WILKIE
CHEMIST & RESEARCH OFFICER

Peter Rutherford

Miscellaneous analyst
report - various issues

1/7/87

Accepted 7/6/83

**GOVERNMENT CHEMICAL LABORATORIES**
30 Plain Street, Perth, Western Australia 6000
Telephone: 325 5544
Address all correspondence to the Director

OUR REF:
YOUR REF:
ENQUIRIES TO:

23 May, 1983 CM.

Department of Fisheries and Wildlife
Western Australian Wildlife
Research Centre
P.O. Box 316
KARRATHA WA 6714

Attention : Mr. K. Morris.

MATERIAL: Thirteen samples of birds which allegedly died as a result of pesticide spraying at Karratha.

LAB No. 82F5706-18

FROM WHOM RECEIVED AND DATE: Department of Fisheries and Wildlife on 7 December, 1982.

RESULT OF EXAMINATION:

The samples as received were not individually marked. The one red-backed kingfisher and eleven sacred kingfishers each weighed approximately 30g and the one mudlark 100g. Analysis was carried out on stomach and contents only. With the eleven kingfishers the eleven stomach and contents were bulked.

Result of examination :

| Sample | Stomach and Contents | | |
|---|---|---|---|
| Species | Mudlark | Red-backed Kingfisher | Sacred Kingfisher |
| Lab No. 82F | 5706 | 5707 | 5708-18 |
| | mg/kg | | |
| Chlordane | 0.88 | 0.12 | 0.07 |
| DDT and metabolites | 1.0 | 0.08 | 0.14 |
| Dieldrin | 14 | 0.54 | 1.2 |
| Heptachlor Epoxide | 2.7 | 1.2 | 0.68 |
| Oxychlordane | 0.63 | 0.21 | 0.10 |

Fenamiphos was detected in the Mudlark's stomach and contents to the extent of 0.12 mg/kg.

No other common organochlorine or organophosphorus pesticides were detected.

The results for stomach and contents indicate that the ingestion of dieldrin and heptachlor may have contributed towards the death of the birds, however this is not conclusive.

F.E. UREN
CHIEF
FOOD & INDUSTRIAL HYGIENE LABORATORY

D.F. HIDE
CHEMIST & RESEARCH OFFICER

Copy to : W.A. Wildlife Research Centre, Mullaloo, W.A. 6025

# MINES DEPARTMENT OF WESTERN AUSTRALIA

GOVERNMENT CHEMICAL LABORATORIES

TEL. No. 23 1443

64 ADELAIDE TERRACE,
PERTH,
W. AUST., 6000.

MCG

Correspondents should–
Confine each letter to one subject.
Write on one side of the paper only.
Address all correspondence to The Director.
Gov't. Chemical Laboratories.

Director,
Department of Fisheries & Fauna
108 Adelaide Tce,
PERTH
W.A.....6000

9th June 1971

OUR REF.....

YOUR REF.....187/71.....

Attn: Mr.Prince

MATERIAL : Two samples as below from carcases of 3 birds (Silvereyes)

LAB. No. 6329-330/71

FROM WHOM RECEIVED AND DATE : Department of Fisheries & Fauna on 12.5.71

RESULT OF EXAMINATION :

| Lab.No. | 6329 | 6330 |
|---|---|---|
| Sample | Heads | Bodies |
| | parts per million | |
| D.D.E | 0.1 | 0.2 |
| D.D.T | 0.1 | 0.1 |
| Dieldrin | 0.1 | 0.1 |
| Fenthion (Lebaycid) | 3.6 | 2.0 |
| Metasystox | N.D. | N.D |

N.D. = not detected.(Limit of detection for metasystox: 0.01 parts per million)

The concentration of fenthion is much higher than the level of organo-phosphorus compounds normally encountered in our examinations of post mortem tissue.

In view of the fact that fenthion is reported to be more toxic to birds than to mammals this concentration appears to be significant although we have no "residue" figures to support this opinion.

N.R.HOUGHTON,
CHIEF OF DIVISION,
FOOD, DRUGS & TOXICOLOGY.

DUPLICATE

6 8

# GOVERNMENT OF WESTERN AUSTRALIA

GOVERNMENT CHEMICAL LABORATORIES
TEL. No. 23 1443
30 PLAIN STREET,
PERTH,
W. AUST., 6000.

BC

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Address all correspondence to The Director.

Director,
Department of Fisheries and Fauna,
108, Adelaide Terrace,
Perth, W.A. 6000.

13th January 1970

OUR REF.

YOUR REF. 187/71

Attention: Mr. Arnold

MATERIAL: One sample (Willy Wagtail)

LAB. No. 18886/69.

FROM WHOM RECEIVED AND DATE: Department of Fisheries and Fauna, on 8/12/1969.

RESULT OF EXAMINATION:

| | parts per million |
|---|---|
| Lindane | 0.02 |
| Aldrin | 0.01 |
| Heptachlor epoxide | 1.0 |
| D.D.E. | 0.85 |
| Dieldrin | 0.05 |
| D.D.T. | 0.05 |

The whole bird, which weighed 18 gram, was comminuted prior to analysis.

No other organochlorine pesticides were detected.

W.R. Wood.

W.R. WOOD,
ASSISTANT CHIEF OF DIVISION,
FOOD, DRUGS AND TOXICOLOGY.

Relic
Hay St.

# MINES DEPARTMENT OF WESTERN AUSTRALIA

GOVERNMENT CHEMICAL LABORATORIES

TEL. No. 23 1443

64 ADELAIDE TERRACE,
PERTH,
W. AUST., 6000. GWD

Correspondents should–
Confine each letter to one subject.
Write on one side of the paper only.
Address all correspondence to The Director.
Gov't. Chemical Laboratories.

Director,
Department of Fisheries & Fauna,
108 Adelaide Terrace,
PERTH 6000.

17th August, 1971

OUR REF.

YOUR REF. 187-71

Attention : Mr. J.A.K. Lane

MATERIAL : Thirty-nine samples of bird tissue, as below.

LAB. No. 8378-410/71 ; 11050-055/71

FROM WHOM RECEIVED AND DATE : Department of Fisheries & Fauna - 22/6/71

RESULT OF EXAMINATION :

| Lab.No. | Marks | | Sample | D.D.E. | D.D.T. | Dieldrin |
|---|---|---|---|---|---|---|
| | | | | parts per million | | |
| 8378 | Pied Cormorant, No.1 | | Liver | 0.02 | 0.01 | 0.01 |
| 8379 | | | Muscle | 0.04 | 0.01 | 0.01 |
| 8380 | Pied Cormorant, No.2 | | Liver | 0.06 | 0.03 | 0.02 |
| 8381 | | | Muscle | 0.07 | 0.02 | 0.01 |
| 8382 | Pied Cormorant, No.3 | Peel Inlet, Feb. 1971 | Liver | 0.01 | 0.01 | 0.01 |
| 8383 | | | Muscle | 0.02 | a | a |
| 8384 | Pied Cormorant, No.4 | Peel Inlet Feb. 1971 | Liver | 0.06 | 0.01 | 0.02 |
| 8385 | | | Muscle | 0.14 | 0.02 | 0.01 |
| 8386 | Pied Cormorant, No.5 | Peel Inlet, Feb. 1971 | Heart | 0.10 | 0.02 | 0.02 |
| 8387 | | | Liver | 0.01 | 0.01 | 0.01 |
| 8388 | | | Muscle | 0.04 | 0.01 | 0.01 |
| 8389 | Little Pied Cormorant. | (12th Feb. Carrabungup Peel Inlet) | Liver | a | 0.01 | 0.01 |
| 8390 | | | Muscle | 0.01 | 0.01 | 0.01 |
| 8391 | Little Pied Cormorant. | Harvey Estuary, 16th Feb. 1971 | Liver | 0.01 | 0.04 | 0.02 |
| 8392 | | | Muscle | 0.01 | 0.02 | 0.01 |
| 8393 | Little Pied Cormorant. | Harvey Estuary, 16th Feb. 1971 | Liver | 0.02 | a | 0.03 |
| 8394 | | | Muscle | 0.02 | 0.01 | 0.01 |
| 8395 | Little Pied Cormorant. | Heron Point, Harvey Estuary 16th Feb. 1971 | Liver | 0.08 | 0.02 | 0.02 |
| 8396 | | | Muscle | 0.04 | 0.01 | 0.01 |
| 8397 | Little Pied Cormorant. | West side of Harvey Estuary 4 miles south of S.D. turn off | Liver | 0.01 | 0.01 | 0.01 |
| 8398 | | | Muscle | 0.01 | 0.01 | a |

JAKL

.contd..

Lab. Nos. 8378-8410/71
11050- 055/71

| Lab.No. | Marks | Sample | D.D.E. | D.D.T. | Dieldrin |
|---|---|---|---|---|---|
| | | | parts per million | | |
| 8399 | Crow No.1. Navara Beach, Peel Inlet 17/2/71 | Liver | a | a | 0.01 |
| 8400 | | Muscle | a | 0.01 | 0.01 |
| 8401 | Crow No.2. Navara Beach, Peel Inlet 17/2/71 | Liver | 0.03 | 0.04 | 0.03 |
| 8402 | | Muscle | 0.05 | 0.03 | 0.02 |
| 8403 | Magpie. 8 miles west of North Dandalup 1545 hours 8/2/71 | Liver | 0.01 | 0.01 | 0.01 |
| 8404 | | Muscle | 0.01 | 0.01 | 0.01 |
| 8405 | Magpie. 4 miles south of S.D. turn off west side of Harvey Estuary | Liver | 0.03 | 0.01 | 0.04 |
| 8406 | | Muscle | 0.01 | a | a |
| 8407 | Crested Tern. Nirimba Cay, Peel Inlet 9/2/71 | Liver | 0.10 | 0.03 | 0.01 |
| 8408 | | Muscle | 0.09 | 0.03 | 0.01 |
| 8409 | Nankeen Kestral. 6 miles off turn off for Heron Pt. 11/2/71 | Liver | a | a | 0.01 |
| 8410 | | Muscle | a | a | a |
| 11050 | Barn Owl. Mandurah - February, 1971 | Muscle | 0.04 | 0.01 | 0.01 |
| 11051 | Coot. Mandurah Rd, Safety Bay turn off 15th Feb. 1971 | Muscle | a | 0.01 | 0.01 |
| 11052 | Black-tailed Godwit. Feb. 1971 - Harvey Estuary | Liver | 0.02 | a | 0.02 |
| 11053 | | Muscle | 0.02 | 0.01 | 0.01 |
| 11054 | White Faced Heron. Navara Beach, Peel Inlet - 17/2/71 | Liver | 0.01 | 0.01 | 0.02 |
| 11055 | | Muscle | 0.01 | 0.01 | a |

a = less than 0.01 parts per million

G.F. EBELL,
CHEMIST

N.R. HOUGHTON,
CHIEF OF DIVISION
FOOD, DRUGS & TOXICOLOGY

DUPLICATE

7 ✓

236/64

# MINES DEPARTMENT OF WESTERN AUSTRALIA

GOVERNMENT CHEMICAL LABORATORIES

TEL. No. 23 1443

64 ADELAIDE TERRACE,
PERTH,
W. AUST., 6000.

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Address all correspondence to The Director, Gov't. Chemical Laboratories.

Director,
Department of Fisheries & Fauna,
108, Adelaide Terrace,
PERTH. W.A. 6000.

2nd March, 1971.

OUR REF.....

YOUR REF. 187/71

Attention: Mr. J.A.K.Lane

MATERIAL: Twenty eight (28) samples of bird tissue, as below.

LAB. No. 1540-567/71.

FROM WHOM RECEIVED AND DATE: Department of Fisheries & Fauna on 8-2-71.

RESULT OF EXAMINATION:

| Lab. No. | Bird | Tissue | D.D.E. | D.D.T. | Dieldrin |
|---|---|---|---|---|---|
| | | | parts per million | | |
| 1540 | Black Duck 1 | Brain | 0.01 | 0.01 | 0.01 |
| 1541 | | Heart | 0.01 | 0.01 | 0.01 |
| 1542 | | Liver | a | a | 0.01 |
| 1543 | | Muscle | 0.01 | 0.02 | 0.01 |
| 1544 | Black Duck 2 | Brain | 0.01 | 0.02 | 0.01 |
| 1545 | | Heart | 0.01 | 0.01 | 0.02 |
| 1546 | | Liver | 0.01 | 0.01 | 0.02 |
| 1547 | | Muscle | 0.01 | 0.01 | 0.01 |
| 1548 | Calidris tenuirostris 1 | Liver | 0.03 | 0.02 | 0.06 |
| 1549 | Calidris tenuirostris | Muscle | 0.02 | 0.02 | 0.02 |
| 1550 | Calidris tenuirostris 2 | Liver | 0.02 | 0.01 | 0.05 |
| 1551 | | Muscle | 0.03 | 0.02 | 0.02 |
| 1552 | Calidris tenuirostris 3 | Liver | 0.01 | 0.01 | 0.03 |
| 1553 | | Muscle | 0.02 | 0.02 | 0.01 |
| 1554 | Calidris tenuirostris 4 | Liver | 0.08 | 0.01 | 0.04 |
| 1555 | | Muscle | 0.20 | 0.02 | 0.03 |
| 1556 | Calidris tenuirostris 5 | Fat | 1.0 | 0.66 | 0.38 |
| 1557 | | Liver | 0.05 | 0.04 | 0.03 |
| 1558 | | Muscle | 0.04 | 0.03 | 0.02 |
| 1559 | Calidris tenuirostris 6 | Fat | 1.2 | 0.46 | 0.73 |
| 1560 | | Liver | 0.02 | 0.01 | 0.01 |
| 1561 | | Muscle | 0.02 | 0.01 | 0.02 |
| 1562 | Calidris tenuirostris 7 | Liver | 0.02 | 0.01 | 0.02 |
| 1563 | | Muscle | 0.06 | 0.03 | 0.01 |
| 1564 | Calidris tenuirostris 8 | Liver | 0.02 | 0.01 | 0.01 |
| 1565 | | Muscle | 0.02 | 0.02 | 0.01 |
| 1566 | Calidris tenuirostris 9 | Liver | 0.02 | 0.01 | 0.03 |
| 1567 | | Muscle | 0.03 | 0.02 | 0.01 |

a = less than 0.01 parts per million.

No organo phosphorus compounds were detected.

Senior Clerk - For distribution of Photo copies

RO ... file on abbreviated file

N.R. HOUGHTON,
CHIEF OF DIVISION,
FOOD, DRUGS & TOXICOLOHY.

Refer Hay St.

# MINES DEPARTMENT OF WESTERN AUSTRALIA

GOVERNMENT CHEMICAL LABORATORIES
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W. AUST., 6000.

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Gov't. Chemical Laboratories.

KMc

Director,
Department of Fisheries & Fauna,
108 Adelaide Terrace,
PERTH.
6000

21st January, 1971

OUR REF.....

YOUR REF. 187/71

FISHERIES
27 JAN 1971
RECORDS

Attention: Mr. J.A.K. Lane

MATERIAL: Eight samples of tissue from birds, as below.

LAB. No. 224–231/71

FROM WHOM RECEIVED AND DATE: Department of Fisheries & Fauna - 7/1/71

RESULT OF EXAMINATION:

| Lab. No. | Marks | D.D.E. | D.D.T. | Dieldrin |
|---|---|---|---|---|
| | | parts per million as received | | |
| | Black Duck 6th Jan., 1971. Mongers Lake | | | |
| 224 | Brain | 0.007 | a | 0.008 |
| 225 | Heart | 0.006 | 0.007 (0.013) | 0.006 |
| 226 | Liver | 0.009 | 0.007 (0.016) | 0.009 |
| 227 | Muscle | 0.007 | 0.006 (0.013) | 0.006 |
| | Black Duck (2) 6th Jan. 1971 Mongers Lake | | | |
| 228 | Brain | 0.010 | a | 0.018 |
| 229 | Heart | 0.028 | 0.005 (0.033) | 0.037 |
| 230 | Liver | 0.012 | 0.020 (0.032) | 0.067 |
| 231 | Muscle | 0.039 | 0.063 (0.102) | 0.052 |

a = not detected (limit of detection: 0.01 parts per million).

$\alpha$-BHC, $\gamma$-BHC(Lindane), heptachlor, heptachlor epoxide, and H.C.B. were detected in all samples at a level below 0.001 parts per million.

N.R. HOUGHTON,
DIVISIONAL CHIEF,
FOODS, DRUGS & TOXICOLOGY.

Mr. Lane. Letter Hay St.

Peter Rutherford

These are the majority of the analysts reports on 'magpie paper' questions.

1/7/07

17 Aug 1971



Lab. Nos. 8378-8410/71
11050- 055/71

| Lab.No. | Marks | Sample | D.D.E. | D.D.T. | Dieldrin |
|---|---|---|---|---|---|
| | | | parts per million | | |
| [illegible] | Magpie. 8 miles south of North Bonaloup [illegible] | Liver | 0.01 | 0.01 | 0.01 |
| 8404 | | Muscle | 0.01 | 0.01 | 0.01 |
| 8405 | Magpie. 4 miles south of S.D. turn off [illegible] | Liver | 0.03 | 0.01 | 0.04 |
| 8406 | | Muscle | 0.01 | a | a |

a = less than 0.01 ppm

G.F. EBELL,
CHEMIST

N.R. HOUGHTON,
CHIEF OF DIVISION
FOOD DRUGS & TOXICOLOGY

6

# MINES DEPARTMENT OF WESTERN AUSTRALIA

GOVERNMENT CHEMICAL LABORATORIES

TEL. No. 23 1443

64 ADELAIDE TERRACE,
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W. AUST., 6000. KMc

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Director,
Department of Fisheries & Fauna,
108 Adelaide Terrace,
PERTH.
6000

21st January, 1971

OUR REF.

YOUR REF. 187/71

Attention: Mr. J.A.K. Lane

MATERIAL: Twelve samples of animal tissue from fish and birds, as below.

LAB. No. 20557-568/70

FROM WHOM RECEIVED AND DATE: Department of Fisheries & Fauna - 31/12/70

RESULT OF EXAMINATION:

| Lab. No. | Marks | D.D.E. | D.D.T. | Dieldrin |
|---|---|---|---|---|
| | | parts per million as received | | |
| | COBBLER | | | |
| | Leschenault Inlet The Plug. 19/12/70 | | | |
| 20557 | Muscle | 0.008 | 0.015 | 0.010 |
| | | 0.023 | | |
| | MAGPIE | | | |
| | 1 mile on Guilderton Rd. from main Lancelin Rd. 20/12/70 | | | |
| 20558 | Muscle | 0.005 | 0.009 | 0.11 |
| | | 1.2 | 0.014 | |
| 20559 | Liver | 0.008 | 0.009 | 0.43 |
| | | | 0.017 | |
| | Watheroo 22/12/70 | | | |
| 20560 | Muscle | 0.018 | 0.009 | 0.022 |
| Liver NA | | | 0.027 | |
| | Marchagee 22/12/70 | | | |
| 20561 | Muscle | 0.007 | 0.003 | 0.005 |
| | | 2.3 | 0.010 | |
| 20562 | Liver | 0.019 | 0.004 | 0.007 |
| | | | 0.023 | |
| | S.E. Corner of Harvey Estuary 22/12/70 | | | |
| 20563 | Muscle | 0.051 | 0.001 | 0.001 |
| | | 3.2 | 0.052 | |
| 20564 | Liver | 0.17 | 0.009 | 0.009 |
| | | | 0.179 | |

./2..

Return Hay St.

| Lab. No. | Marks | D.D.E. | D.D.T. | Dieldrin |
|---|---|---|---|---|
| | | parts per million as received | | |
| | **MAGPIE** | | | |
| | Robert Bay, Peel Inlet. 24/12/70 | | | |
| 20565 | Muscle | 0.005 | 0.002 | 0.002 |
| 20566 | Liver | 0.009 | 0.002 | 0.003 |
| | Greensland Rd., Pinjarra. 24/12/70 | | | |
| 20567 | Muscle | 0.005 | 0.001 | 0.002 |
| 20568 | Liver | 0.010 | 0.001 | 0.006 |

$\alpha$ - BHC, $\gamma$ -BHC(Lindane), heptachlor, heptachlor epoxide, and H.C.B. were detected in all samples at a level below 0.001 parts per million.

N.R. HOUGHTON,
DIVISIONAL CHIEF,
FOODS, DRUGS & TOXICOLOGY.

Department of Mines, Western Australia

**GOVERNMENT CHEMICAL LABORATORIES**

30 Plain St., Perth, Western Australia, 6000. Tel. 25 5544

Address all correspondence to the Director.

Correspondents should confine each letter to one subject. Write on one side of the paper only.

Director
Department of Fisheries & Fauna
108 Adelaide Tce
Perth
W.A.....6000

4th July 1974 MCG

Attention: Mr. J. Lane

OUR REF:

YOUR REF: 187/71

MATERIAL: Fifty seven samples of Magpie tissue (29 muscle, 28 liver) from birds in the S.W. of the State, as below.

LAB. No. 12602-58/74

FROM WHOM RECEIVED AND DATE: Dept of Fisheries & Fauna on 18.6.74

RESULT OF EXAMINATION:

Muscle samples

| Sample | Lab.No. | DDT + metabolites | Dieldrin |
|---|---|---|---|
| | | parts per million as received | |
| 119M ✓ | 12602 | 0.04 | 0.002 |
| 120M ✓ | 12603 | 0.004 | 0.002 |
| 121M ✓ | 12604 | 0.004 | 0.002 |
| 122M ✓ | 12605 | 0.02 | 0.002 |
| 123M ✓ | 12606 | 0.4 | 0.3 |
| 124M ✓ | 12607 | 9.0 | 0.01 |
| 125M ✓ | 12608 | 0.4 | 0.5 |
| 126M ✓ | 12609 | 0.9 | 0.2 |
| 127M ✓ | 12610 | 0.2 | 0.03 |
| 128M ✓ | 12611 | 0.4 | 0.4 |
| 129M ✓ | 12612 | 0.4 | 0.2 |
| 130M ✓ | 12613 | 0.8 | 0.3 |
| 131M ✓ | 12614 | 1.2 | 0.02 |
| 132M ✓ | 12615 | 0.3 | 0.008 |
| 133M ✓ | 12616 | 14 | 0.1 |
| 134M ✓ | 12617 | 4.2 | 3.2 |
| 135M ✓ | 12618 | 3.8 | 0.6 |
| 136M ✓ | 12619 | 0.05 | 0.004 |
| 137M ✓ | 12620 | 3.8 | 0.4 |
| 138M ✓ | 12621 | 1.8 | 1.6 |
| 139M ✓ | 12622 | 0.01 | 0.005 |
| 140M ✓ | 12623 | 2.3 | 1.1 |
| 141M ✓ | 12624 | 0.4 | 0.1 |
| 142M ✓ | 12625 | 0.3 | 0.2 |
| 143M ✓ | 12626 | 0.3 | 0.03 |
| 144M ✓ | 12627 | 1.2 | 0.3 |
| 145M ✓ | 12628 | 0.4 | 0.1 |
| 146M ✓ | 12629 | 0.4 | 0.1 |
| 147M ✓ | 12630 | 0.08 | 0.02 |

Liver samples

| Sample | Lab.No. | DDT + metabolites | Dieldrin |
|---|---|---|---|
| | | parts per million as received | |
| 119L | 12631 | 0.02 | 0.02 |
| 120L | 12632 | 0.008 | 0.01 |
| 121L | 12633 | 0.006 | 0.01 |
| 122L | 12634 | 0.02 | 0.01 |
| 123L | 12635 | 2.0 | 1.7 |
| 124L | 12636 | 25 | 0.18 |
| 125L | 12637 | 3.4 | 3.4 |
| 126L | 12638 | 3.2 | 1.0 |
| 127L | 12639 | 0.2 | 0.06 |
| 128L | 12640 | 1.7 | 1.7 |
| 129L | 12641 | 1.2 | 1.5 |
| 130L | 12642 | 3.6 | 1.8 |
| 131L | 12643 | 1.7 | 0.1 |
| 132L | 12644 | 0.5 | 0.1 |
| 134NA 133L | 12645 | 8.2 | 0.05 |
| 135L | 12646 | 6.8 | 1.1 |
| 136L | 12647 | 0.01 | 0.008 |
| 137L | 12648 | 9.8 | 0.4 |
| 138L | 12649 | 3.2 | 3.2 |
| 139L | 12650 | 0.02 | 0.007 |
| 140L | 12651 | ? 33 | 12 |
| 141L | 12652 | 1.7 | 0.7 |
| 142L | 12653 | 0.5 | 0.5 |
| 143L | 12654 | 1.7 | 0.2 |
| 144L | 12655 | 3.8 | 2.2 |
| 145L | 12656 | 0.6 | 0.2 |
| 146L | 12657 | 0.5 | 0.3 |
| 147L | 12658 | 0.2 | 0.05 |

No other common organo-chlorine pesticides were detected.

A.T.WILKIE
G.F.EBELL
CHEMIST & RESEARCH OFFICER

N.R.HOUGHTON
CHIEF OF DIVISION
FOOD, DRUGS & TOXICOLOGY

Department of Mines, Western Australia
**GOVERNMENT CHEMICAL LABORATORIES**
30 Plain St., Perth, Western Australia, 6000. Tel. 25 5544

Address all correspondence to the Director.
Correspondents should confine each letter to one subject. Write on one side of the paper only.

Director
Department Fisheries & Fauna
108 Adelaide Tce
Perth

7th May 1974 MCG

Attention: Mr. R. Prince

OUR REF:

YOUR REF: 187/71

MATERIAL: Eighty nine samples of bird tissue.

LAB. No. 443-531/74

FROM WHOM RECEIVED AND DATE: Dept of Fisheries & Fauna on 9.1.74

RESULT OF EXAMINATION:

| Sample | Lab.No | | D.D.T + metabolites | Dieldrin |
|---|---|---|---|---|
| | | | parts per million | |
| **(A) Magpie** | | | | |
| 37 M | 443 | | 0.1 | 0.1 |
| 37 L | 444 | | 0.7 | 1.0 |
| 38 M | 445 | | 0.04 | less than 0.005 |
| 38 L | 446 | | 0.06 | 0.02 |
| 39 M | 447 | | 0.04 | 0.01 |
| 39 L | 448 | | 0.05 | 0.2 |
| 40 M | 449 | | 0.05 | 0.01 |
| 40 L | 450 | | 0.1 | 0.04 |
| 41 M | 451 | | 0.06 | 0.01 |
| 41 L | 452 | | 0.08 | 0.01 |
| 42 M | 453 | | 0.05 | 0.005 |
| 42 L | 454 | | 0.2 | 0.1 |
| 43 M | 455 | | 0.09 | less than 0.005 |
| 43 L | 456 | | 0.3 | 0.1 |
| 44 M | 457 | | 0.2 | less than 0.005 |
| 44 L | 458 | | 0.4 | 0.05 |
| 45 M | 459 | | 0.2 | less than 0.005 |
| 45 L | 460 | | 0.2 | 0.02 |
| 46 M | 461 | | 0.1 | 0.01 |
| 46 L | 462 | | 0.06 | 0.02 |
| 47 M | 463 | | 0.05 | less than 0.005 |
| 47 L | 464 | | 0.04 | less than 0.005 |

| Sample | Lab.No | D.D.T + metabolites | | Dieldrin |
|---|---|---|---|---|
| | | parts per million | | |
| Magpie | | | | |
| 48 M | 465 | 0.67 | 0.06 | less than 0.005 |
| 48 L | 466 | | 0.04 | less than 0.005 |
| 49 M | 467 | 2.0 | 0.1 | less than 0.005 |
| 49 L | 468 | | 0.2 | less than 0.005 |
| 50 M | 469 | 2.0 | 0.02 | less than 0.005 |
| 50 L | 470 | | 0.04 | less than 0.005 |
| 51 M | 471 | 1.0 | 0.02 | less than 0.005 |
| 51 L | 472 | | 0.02 | less than 0.005 |
| 52 M | 473 | 2.5 | 0.04 | less than 0.005 |
| 52 L | 474 | | 0.1 | less than 0.005 |
| 53 M | 475 | 5x | 0.01 | less than 0.005 |
| 53 L | 476 | | 0.05 | less than 0.005 |
| 54 M | 477 | 2.5 | 0.04 | 0.002 |
| 54 L | 478 | | 0.1 | 0.02 |
| 55 M | 479 | 4x | 0.005 | less than 0.002 |
| 55 L | 480 | | 0.02 | less than 0.002 |
| 56 M | 481 | 2x | 0.005 | less than 0.002 |
| 56 L | 482 | | 0.01 | less than 0.002 |
| 57 M | 483 | 1.0 | 0.01 | less than 0.002 |
| 57 L | 484 | | 0.01 | less than 0.002 |
| 58 M | 485 | 2.0 | 0.01 | less than 0.002 |
| 58 L | 486 | | 0.02 | less than 0.005 |
| 59 M | 487 | 1.0 | 0.01 | 0.002 |
| 59 L | 488 | | 0.01 | 0.01 |
| 60 M | 489 | 3.3 | 0.03 | less than 0.002 |
| 60 L | 490 | | 0.1 | less than 0.002 |
| 61 M | 491 | 1.75 | 0.004 | less than 0.002 |
| 61 L | 492 | | 0.007 | less than 0.002 |
| 62 M | 493 | 1.75 | 0.004 | less than 0.002 |
| 62 L | 494 | | 0.007 | less than 0.002 |
| 63 M | 495 | 3.5 | 0.002 | less than 0.002 |
| 63 L | 496 | | 0.007 | less than 0.002 |
| 64 M | 497 | 0.58 | 0.007 | less than 0.002 |
| 64 L | 498 | | 0.004 | less than 0.002 |
| 65 M | 499 | 0.5 | 0.02 | less than 0.002 |
| 65 L | 500 | | 0.01 | 0.004 |
| 66 M | 501 | 3.0 | 0.002 | less than 0.002 |
| 66 L | 502 | | 0.006 | 0.004 |

| Sample | Lab.No | | D.D.T + metabolites | Dieldrin |
|---|---|---|---|---|
| | | | parts per million | |
| **Magpie** | | | | |
| 67 M | 503 | 25 | 0.04 | 0.03 |
| 67 L | 504 | | 0.1 | 0.4 |
| 68 M | 505 | | 0.3 | 0.07 |
| 68 L | 506 | 40 | 1.2 | 0.5 |
| 69 M | 507 | | 0.006 | 0.002 |
| 69 L | 508 | 1.67 | 0.01 | 0.009 |
| 70 M | 509 | | 0.01 | 0.002 |
| 70 L | 510 | 30 | 0.03 | 0.02 |
| 71 M | 511 | | 0.01 | 0.003 |
| 71 L | 512 | 60 | 0.06 | 0.02 |
| 72 M | 513 | | 0.02 | 0.01 |
| 72 L | 514 | 30 | 0.06 | 0.03 |
| 73 M | 515 | | 0.03 | 0.003 |
| 73 L | 516 | 23 | 0.07 | 0.01 |
| (B) Boobook Owl | | | | |
| 73/OR/8 M | 517 | | 1.8 | less than 0.2 |
| 73/OR/8 L | 518 | | 1.6 | less than 0.2 |
| 73/OR/8 F | 519 | | 60 | less than 5 |
| 73/OR/8 S.C | 520 | | 5.5 | less than 0.2 |
| (C) Masked Owl | | | | |
| B | 521 | | 0.3 | less than 0.05 |
| H | 522 | | 0.6 | less than 0.05 |
| M(a) | 523 | | 0.06 | less than 0.005 |
| M(b) | 524 | | 0.03 | less than 0.002 |
| (D) Crow (Corvus sp.) | | | | |
| 4 L | 525 | 1.5x | 0.03 | 0.06 |
| 4 M | 526 | | 0.02 | 0.03 |
| 7 L | 527 | 2.5x | 0.005 | 0.003 |
| 7 M | 528 | | 0.002 | 0.002 |
| 9 F | 529 | | 0.2 | 0.06 |
| 9 L | 530 | 10x | 0.02 | 0.02 |
| 9 M | 531 | | 0.002 | 0.002 |

No other common organo-chlorine pesticides were detected.

J.M.CHALLINOR
CHEMIST & RESEARCH OFFICER

W.R.Wood.

W.R.WOOD
ASST.CHIEF OF DIVISION
FOOD, DRUGS & TOXICOLOGY

Department of Mines, Western Australia

**GOVERNMENT CHEMICAL LABORATORIES**

30 Plain St., Perth, Western Australia, 6000. Tel. 25 5544

Director
Department of Fisheries and Fauna
108 Adelaide Terrace
Perth
W.A.....6000

Attention: Mr. Prince

Correspondents should confine each letter to one subject. Write on one side of the paper only. Address all correspondence to the Director.

MCG

5th January 1972

OUR REF:

YOUR REF: 187/71, 13/7/'71

MATERIAL: Thirty samples of bird (Magpie) tissue as below.

LAB. No. 15156-185/71

FROM WHOM RECEIVED AND DATE: Department of Fisheries and Fauna on 18.10.71

RESULT OF EXAMINATION:

| Sample | Lab.No | γ-B.H.C (Lindane) | | D.D.E | D.D.T | Dieldrin |
|---|---|---|---|---|---|---|
| | | | | parts per million* | | |
| 22L ♀ | 15156 | 0.01 | 2. | 0.08 | 0.20 | 0.08 |
| 22M | 15157 | 0.01 | | 0.03 | 0.10 | 0.03 |
| 23L ♀ | 15158 | a | 3. | 0.01 | 0.02 | 0.10 |
| 23M | 15159 | a | | a | 0.01 | 0.02 |
| 24L ♀ | 15160 | N.D. | 1.3 | 0.02 | 0.02 | 0.08 |
| 24M | 15161 | N.D. | | 0.01 | 0.02 | 0.02 |
| 25L | 15162 | a | 1.7 | 0.01 | 0.04 | 0.02 |
| 25M | 15163 | a | | 0.01 | 0.02 | 0.01 |
| 26L | 15164 | a | 2.0 | 0.02 | 0.06 | 0.02 |
| 26M | 15165 | a | | 0.01 | 0.03 | 0.01 |
| 27L | 15166 | N.D. | 1.0 | 0.02 | 0.02 | 0.03 |
| 27M | 15167 | N.D. | | 0.03 | 0.01 | 0.02 |
| 28L | 15168 | N.D. | 2.0 | 6.2 | 0.62 | 3.1 |
| 28M | 15169 | N.D. | | 3.2 | 0.20 | 1.5 |
| 29L | 15170 | a | 0.75 | 0.01 | 0.02 | 0.01 |
| 29M | 15171 | N.D. | | 0.02 | 0.02 | 0.01 |
| 30L | 15172 | N.D. | 2.0 | 0.08 | 0.02 | 0.01 |
| 30M | 15173 | N.D. | | 0.03 | 0.02 | 0.01 |
| 31L | 15174 | N.D. | 0.3 | 0.11 | 0.02 | 0.04 |
| 31M | 15175 | N.D. | | 0.02 | 0.01 | 0.01 |
| 32L | 15176 | N.D. | 0.67 | 0.01 | 0.01 | 0.14 |
| 32M | 15177 | N.D. | | 0.01 | 0.02 | 0.03 |
| 33L | 15178 | 0.02 | 3.4 | 0.14 | 0.40 | 0.16 |
| 33M | 15179 | 0.01 | | 0.03 | 0.12 | 0.04 |

2/-

GOVERNMENT CHEMICAL LABORATORIES.

Lab.No.15156-185/71. (Copy).

| | Sample | Lab.No. | -B.H.C. (Lindane) | | D.D.E. parts per million* | D.D.T. parts per million* | Dieldrin parts per million* |
|---|---|---|---|---|---|---|---|
| ♂ 4+ | 34L | 15180 | a | 3.2 | 0.10 | 0.03 | 0.14 |
| | 34M | 15181 | N.D. | | 0.02 | 0.02 | 0.02 |
| ♀ 3yrs | 35L | 15182 | a | 1.0 | 0.04 | 0.02 | 0.14 |
| | 35M | 15183 | N.D. | | 0.01 | 0.01 | 0.07 |
| ♂ 2nd year | 36L | 15184 | N.D. | 4.7 | 1.0 | 0.25 | 0.05 |
| | 36M | 15185 | N.D. | | 0.25 | 0.02 | 0.01 |

*on sample as received.

a = Less than 0.01 parts per million.
N.D.= Not detected. Limits of detection, 0.001 parts per million.

12/1/72

Duplicate page 2 of Report not received

Originals filed on 18/1/71.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ♀ 4yrs | 30L | 15172 | N.D. | 2.0 | 0.08 | 0.02 | 0.01 |
| | 30M | 15173 | N.D. | | 0.03 | 0.02 | 0.01 |
| ♂ 4+ | 31L | 15174 | N.D. | 4.3 | 0.11 | 0.02 | 0.04 |
| | 31M | 15175 | N.D. | | 0.02 | 0.01 | 0.01 |
| ♂ 4yrs | 32L | 15176 | N.D. | 0.67 | 0.01 | 0.01 | 0.14 |
| | 32M | 15177 | N.D. | | 0.01 | 0.02 | 0.03 |
| ♂ 5-6yrs | 33L | 15178 | 0.02 | 3.4 | 0.14 | 0.40 | 0.16 |
| | 33M | 15179 | 0.01 | | 0.03 | 0.12 | 0.04 |

2/-

# MINES DEPARTMENT OF WESTERN AUSTRALIA

GOVERNMENT CHEMICAL LABORATORIES

TEL. No. ~~XXXX~~ 25 5544

64 ADELAIDE TERRACE,
PERTH, AvdL
W. AUST., 6000.

Correspondents should–
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Write on one side of the paper only.
Address all correspondence to The Director.
Gov't. Chemical Laboratories.

The Director,
Department of Fisheries and Fauna,
108 Adelaide Terrace,
PERTH, 6000,
Western Australia.

27th August, 1971.

OUR REF.

YOUR REF. 187/71

Attention:
Mr. Prince.

MATERIAL: Twenty four (24) samples of bird tissue collected in the South-West.

LAB. No. 10175-198/71

FROM WHOM RECEIVED AND DATE: Fisheries & Fauna on 5th August, 1971.

RESULT OF EXAMINATION:

| | Lab. No's. | Marks | | D.D.E. | D.D.T. | Dieldrin |
|---|---|---|---|---|---|---|
| | | | | parts per million | | |
| ♀ 3rd moult | 10175 | 10 Liver | 3.0 | 0.05 | 0.01 | 0.02 |
| | 10176 | 10 Muscle | | 0.01 | 0.01 | a |
| ♂ 4+ | 10177 | 11 Liver | 1.4 | 0.06 | 0.01 | 0.03 |
| | 10178 | 11 Muscle | | 0.04 | 0.01 | a |
| ♀ 3rd moult | 10179 | 12 Liver | 1.0 | 0.04 | 0.01 | 0.02 |
| | 10180 | 12 Muscle | | 0.04 | 0.01 | 0.02 |
| ♂ 4+ yearl | 10181 | 13 Liver | 1.75 | 0.01 | 0.01 | 0.02 |
| | 10182 | 13 Muscle | | 0.01 | a | a |
| ♂ 4+ | 10183 | 14 Liver | 1.75 | 0.08 | 0.01 | 0.02 |
| | 10184 | 14 Muscle | | 0.05 | a | 0.01 |
| ♂ 4+ | 10185 | 15 Liver | ? | a | 0.01 | 0.01 |
| | 10186 | 15 Muscle | | a | a | a |
| ♂ 5-6yrs | 10187 | 16 Liver | 3.5 | 0.40 | 0.01 | 0.22 |
| | 10188 | 16 Muscle | | 0.16 | a | 0.03 |
| ♀ 3rd moult | 10189 | 17 Liver | 2.0 | 0.8 | 1.0 | 0.6 |
| | 10190 | 17 Muscle | | 0.40 | 0.50 | 0.30 |
| ♂ 3rd moult | 10191 | 18 Liver | 3.3 | 0.17 | 0.02 | 0.10 |
| | 10192 | 18 Muscle | | 0.05 | 0.01 | a |
| ♂ 3rd moult | 10193 | 19 Liver | ? | 0.01 | a | 0.01 |
| ♀ 1st moult | 10194 | 19 Muscle | | a | a | a |
| | 10195 | 20 Liver | 1.0 | a | a | 0.03 |
| | 10196 | 20 Muscle | | a | a | 0.01 |
| ♂ 1st moult | 10197 | 21 Liver | 3.2 | 0.14 | 0.02 | 0.30 |
| | 10198 | 21 Muscle | | 0.04 | 0.01 | 0.10 |

a = less than 0.01 parts per million.

N.R. HOUGHTON,
CHIEF OF DIVISION,
FOOD, DRUGS AND TOXICOLOGY.

A.M. STENHOUSE,
CHEMIST-RESEARCH OFFICER.

Duplicate

# MINES DEPARTMENT OF WESTERN AUSTRALIA

GOVERNMENT CHEMICAL LABORATORIES

TEL. No. 23 1443

64 ADELAIDE TERRACE,
PERTH,
W. AUST., 6000.

LMc

Correspondents should–
Confine each letter to one subject.
Write on one side of the paper only.
Address all correspondence to The Director.
Gov't. Chemical Laboratories.

Director,
Department of Fisheries & Fauna,
108 Adelaide Terrace,
PERTH.....W.A. 6000

27th July, 1971.

File 197/71

YOUR REF.....

Attention: Mr. Prince.

MATERIAL : Twelve samples of bird tissues from the South-West, as below.

LAB. No. 9907-918/71

FROM WHOM RECEIVED AND DATE :
Department of Fisheries & Fauna, on 14/7/71

RESULT OF EXAMINATION :

| Marks | Lab. No. | | D.D.E. | D.D.T. | Dieldrin |
|---|---|---|---|---|---|
| | | | parts per million | | |
| No. 1 Liver | 9907 | 1.8 | 0.57 | 0.04 | 0.04 |
| No. 1 Muscle | 9908 | | 0.32 | 0.03 | 0.01 |
| No. 2 Liver | 9909 | 2.7 | 1.9 | 0.03 | 0.03 |
| No. 2 Muscle | 9910 | | 0.73 | 0.02 | 0.01 |
| No. 3 Liver | 9911 | 4.- | 0.07 | 0.01 | 0.02 |
| No. 3 Muscle | 9912 | | 0.02 | a | 0.01 |
| No. 5 Liver | 9913 | 4.0 | 0.30 | 0.02 | 0.02 |
| No. 5 Muscle | 9914 | | 0.07 | 0.01 | 0.01 |
| No. 6 Liver | 9915 | 3.8 | 0.03 | 0.01 | 0.01 |
| No. 6 Muscle | 9916 | | 0.01 | a | a |
| No. 8 Liver | 9917 | 3.0 | 0.02 | a | 0.01 |
| No. 8 Muscle | 9918 | | 0.01 | a | a |

a = less than 0.01 parts per million.

No organo-phosphorus insecticides were detected in any of the above samples.

G.F. EBELL,
CHEMIST & RESEARCH OFFICER.

N.R. HOUGHTON,
CHIEF OF DIVISION,
FOOD, DRUGS & TOXICOLOGY.

Retain. Hay St

DUPLICATE
Department of Mines, Western Australia 37

**GOVERNMENT CHEMICAL LABORATORIES**

30 Plain St., Perth, Western Australia, 6000. Tel. 25 5544

Correspondents should confine each letter to one subject. Write on one side of the paper only Address all correspondence to the Director

Department of Fisheries & Fauna
108 Adelaide Terrace
PERTH
W.A. 6000.

4 July 1972 BC

Attention: Mr. Prince.

OUR REF:

YOUR REF: 187/71

MATERIAL: Four samples of bird tissue, as below (ref R.P.Donnelly, 28, Walter Street, Claremont).

A Mayfair

LAB. No. 19887-890/71.

FROM WHOM RECEIVED AND DATE: Department of Fisheries and Fauna on 31.12.71.

RESULT OF EXAMINATION:

| Sample | Lab.No. (1971) | D.D.E. | Dieldrin |
|---|---|---|---|
| | | parts per million | |
| Brain | 19887 | 3.6 | 6 |
| Heart | 19888 | 8.4 | 12 |
| Liver | 19889 | 12 | 19 |
| Muscle | 19890 | 9.6 | 13 |

1-27

→ Result upheld on appeal pm.

No other organo-chlorine insecticides were detected. (Limit of detection for D.D.T,0.1 part per million).

Analysis of the samples was considerably delayed because of damage by fire to the Laboratories and equipment. In view of this delay and the instability of organo-phosphorus insecticides in aqueous tissue, analysis was confined to the organo-chlorine insecticides.

No significant concentration of D.D.T. was detected. This is consistent with figures quoted by the Infestation Control Laboratory of the Ministry of Agriculture, Fisheries and Food, United Kingdom, in their Report for 1962-64, pages 23-47.

A.E. STENHOUSE.
A.E. STENHOUSE
CHEMIST & RESEARCH OFFICER.

N.R. HOUGHTON
CHIEF OF DIVISION
FOOD, DRUGS & TOXICOLOGY.

Ft 4
187/71

36

The Director,
Govt. Chemical Laboratories,
64 Adelaide Tce.,
PERTH. 6000

Mr. Prince
187/71

31st December, 1971.

Attention: Mr. Houghton

Could you please arrange for the appropriate pesticide residue analyses on the tissue samples forwarded herewith.

These samples comprise:-

1) Brain
2) Heart
3) Liver
4) Muscle

(The gizzard of this bird was practically empty).

from a magpie presented to this Department by a Mr. E.P. Donnelly, 28 Walter Street Claremont, on 10th December, 1971.

The bird was found in distress about 8 a.m. on this date with no obvious signs of injury, and died shortly afterwards. The carcase was delivered about 9 a.m. on the same day and immediately placed in the deep freeze.

Mr. Donnelly informed us that he had used Malathion and Metasystox on tomatoes and D.D.T. on roses in his garden. He had also used some other compound for killing nematodes, but could not give any other specific information as to the name of this substance.

B. K. Bowen,
DIRECTOR

folio 37 was duplicate of report proof folio 38

folio 37 retained 21.1.72

A.M. STENHOUSE
CHEMIST & RESEARCH OFFICER.

N.R. HOUGHTON
CHIEF OF DIVISION
FOOD, DRUGS & TOXICOLOGY.

Grasshopper Spraying 1971

Mingenew Area.

'Nangetty'; 'Urella'; 'Mungatarra'.

Initial applications tried 4 ozs active ingredient per acre - this was rate over 'Nangetty' where our samples were obtained.

The results showed that the effect was not as required and that the rate of application tried subsequently over part of 'Urella' and over 'Mungatarra' apparently was 6.5 ozs per acre. Rate of application at grand level was not known in either case.

The original area will have to be redone apparently.

Grasshopper Spraying
-Mingenew Area.
'Nangetty', 'Urella', 'Mungaterra'

4 ounces

Initial applications tried 4oz active ingredient per acre - this was rate on 'Nangetty' where our samples were obtained.

The results showed that the effect was not as required and that the rate of application tried subsequently over part of 'Urella' and over 'Mungaterra' apparently was 6.5 ozs per acre. Rate of application at ground level was not known in either case.

The original area will have to be redone apparently.

Peter Rutherford

The attached are the analysis reports from the samples we did at MINGENEW when AFB were spraying locusts. The Malathion was not detectable, we asked for DDT, etc as additional.

The reported attached here is for birds and grasshopper from areas sprayed just before we sampled.

Peter 1/7/87.

DUPLICATE

# MINES DEPARTMENT OF WESTERN AUSTRALIA

GOVERNMENT CHEMICAL LABORATORIES

TEL. No. 25 5544

64 ADELAIDE TERRACE,
PERTH,
W. AUST., 6000. BC

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Director,
Department of Fisheries & Fauna,
108, Adelaide Terrace,
Perth,
W.A. 6000.

20th September, 1971

OUR REF.....

YOUR REF. 187/71

Attn.: Mr. Prince.

MATERIAL: Fifty three bird tissues, marked as below.

LAB. No. 12743-795/71.

FROM WHOM RECEIVED AND DATE: Department of Fisheries & Fauna on 3.9.71.

RESULT OF EXAMINATION:

parts per million

| Lab.No. | Sample | | D.D.D. | D.D.E. | D.D.T. | Dieldrin | H.C.B. |
|---|---|---|---|---|---|---|---|
| | | **Area 1** | | | | | |
| | | Banded Plover | | | | | |
| 12743 | 109 | Liver | ND | ND | ND | 0.01 | a |
| 12744 | | Muscle | ND | ND | ND | a | a |
| | | Brown Song Lark | | | | | |
| 12745 | 106 | Liver | ND | a | a | a | a |
| 12746 | | Muscle | ND | ND | ND | a | ND |
| 12747 | 105 | Liver | ND | 0.01 | 0.01 | 0.01 | ND |
| 12748 | | Muscle | ND | ND | ND | a | ND |
| 12749 | 104 | Liver | ND | 0.01 | 0.01 | 0.01 | ND |
| 12750 | | Muscle | ND | ND | ND | a | ND |
| 12751 | 103 | Liver | ND | 0.04 | 0.01 | 0.01 | 0.02 |
| 12752 | | Muscle | ND | a | a | a | a |
| 12753 | 102 | Liver | ND | 0.01 | 0.01 | 0.01 | a |
| 12754 | | Muscle | ND | ND | ND | a | ND |
| | | **Area 2** | | | | | |
| | | Peewit | | | | | |
| 12755 | 108 | Liver | ND | a | a | 0.01 | ND |
| 12756 | | Muscle | ND | a | a | a | ND |
| 12757 | 107 | Liver | ND | 0.01 | a | 0.01 | a |
| 12758 | | Muscle | ND | a | a | a | a |
| | | **Area 3** | | | | | |
| | | Banded Plover | | | | | |
| 12759 | 97 | Liver | 0.4 | 0.6 | 0.6 | a | 0.04 |
| 12760 | | Muscle | 0.1 | 0.4 | 0.4 | a | 0.02 |
| 12761 | 96 | Liver | ND | ND | ND | a | 0.2 |
| 12762 | | Muscle | ND | ND | ND | a | 0.04 |

contd.....

| Lab.No. | Sample | | D.D.D. | D.D.E. | D.D.T. | Dieldrin | H.C.B. |
|---|---|---|---|---|---|---|---|
| | | | parts per million | | | | |
| | | Area 4A | | | | | |
| | | Brown Song Lark | | | | | |
| 12763 | 98 | Liver | ND | a | 0.01 | 0.01 | a |
| 12764 | | Muscle | ND | a | a | a | ND |
| 12765 | 101 | Liver | ND | 0.01 | a | 0.01 | 0.01 |
| 12766 | | Muscle | ND | a | ND | a | a |
| | | Area 4B | | | | | |
| | | Brown Song Lark | | | | | |
| 12767 | 99 | Liver | ND | a | ND | 0.01 | ND |
| 12768 | | Muscle | ND | ND | ND | a | ND |
| 12769 | 100 | Liver | ND | 0.01 | 0.01 | 0.01 | 0.02 |
| 12770 | | Muscle | ND | a | ND | a | a |
| | | Area 5 | | | | | |
| | | Banded Plover | | | | | |
| 12771 | 95 ? | Liver | ND | a | a | a | 0.02 |
| 12772 | | Muscle | 0.02 | 0.06 | 0.06 | a | 0.01 |
| | | Pipit | | | | | |
| 12773 | 94 | Liver | ND | 0.01 | 0.02 | 0.02 | a |
| 12774 | | Muscle | ND | a | ND | a | ND |
| | | Brown Song Lark | | | | | |
| 12775 | 93 | Liver | ND | a | a | 0.01 | a |
| 12776 | | Muscle | ND | ND | ND | a | ND |
| 12777 | | Grasshoppers live | ND | ND | ND | a | ND |
| 12778 | | Grasshoppers dead | ND | ND | ND | a | ND |
| | | Area 1 | | | | | |
| 12779 | 109 | Banded Plover Brain | not analysed* | | | | |
| 12780) to 12784) | 102 to 106 | Brown Song Lark Brains | ND | a | ND | a | ND |
| | | Area 2 | | | | | |
| 12785) & 12786) | 107, 108 | Peewit Brains | ND | ND | ND | a | ND |
| | | Area 3 | | | | | |
| 12787 & 12788 | 96, 97 | Banded Plover Brains | 0.02 | 0.1 | 0.1 | a | 0.02 |

4 2 4

contd.....

| Lab.No. | Sample | | D.D.D. | D.D.E. | D.D.T. | Dieldrin | H.C.B. |
|---|---|---|---|---|---|---|---|
| | | | parts per million | | | | |
| | | Area 4A | | | | | |
| 12789 & 12790 | 98, 101 | Brown Song Lark Brains | ND | ND | ND | a | ND |
| | | Area 4B | | | | | |
| 12791 & 12792 | 99, 100 | Brown Song Lark Brains | ND | ND | ND | a | a |
| | | Area 5 | | | | | |
| 12793 | 95 | Banded Plover Brains | * not analysed | | | | |
| 12794 | 94 | Pipit Brains | * not analysed | | | | |
| 12795 | 93 | Brown Song Lark Brains | * not analysed | | | | |

a= less than 0.01 parts per million

ND= not detected. Limit of detection 0.001 parts per million.

*= not analysed - insufficient sample.

No organo-phosphate insecticides were detected in the above bird tissue samples. The limit of detection for maldison was 0.001 parts per million.

Maldison was detected in the grasshopper samples, as under:

| Lab. No. | Marks | Maldison parts per million |
|---|---|---|
| 12777 | Grasshoppers live | 0.4 |
| 12778 | Grasshoppers dead | 1 |

G.F. Ebell per
A.M. Stenhouse

G.F. EBELL,
A.M. STENHOUSE,
CHEMISTS.

N.R. HOUGHTON,
CHIEF OF DIVISION,
FOOD, DRUGS & TOXICOLOGY.

Peter Rutherford

The attached analysts' report is for birds collected from areas not yet sprayed by APB for locust control with Malathion. mid 1971. — collected same time as those from areas sprayed.

1/7/87

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 12284 | | | Muscle | a | a | a | |
| 12285 | 83 | Banded Plover | Liver | a | a | 0.01 | 0.01 |
| 12286 | | | Muscle | a | a | a | 0.03 |

./2.

duplicate

# MINES DEPARTMENT OF WESTERN AUSTRALIA

GOVERNMENT CHEMICAL LABORATORIES

TEL. No. 25 5544

64 ADELAIDE TERRACE,
PERTH,
W. AUST., 6000. KMc

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Gov't. Chemical Laboratories.

Director,
Department of Fisheries & Fauna,
108 Adelaide Terrace,
PERTH.
6000

10th September, 1971

OUR REF.

YOUR REF. 187/71

Attention: Mr. Prince

MATERIAL : Fifty-seven samples of bird tissue collected from the Mingenew District, as below.

LAB. No. 12267-323/71

FROM WHOM RECEIVED AND DATE : Department of Fisheries & Fauna - 30/8/71

RESULT OF EXAMINATION :

| Lab. No. (1971) | Sample No. | Marks | D.D.E. | D.D.T. | Dieldrin | H.C.B. |
|---|---|---|---|---|---|---|
| | | | parts per million | | | |
| 12267 | 74 | Crested Pigeon Liver | a | 0.01 | 0.01 | b |
| 12268 | | Muscle | a | a | a | b |
| 12269 | 75 | Magpie Liver | 0.01 | a | 0.01 | b |
| 12270 | | Muscle | a | a | a | b |
| 12271 | 76 | Magpie Liver | 0.02 | 0.01 | 0.01 | b |
| 12272 | | Muscle | 0.01 | a | a | b |
| 12273 | 77 | Peewit Liver | 0.01 | a | 0.01 | b |
| 12274 | | Muscle | 0.01 | a | a | b |
| 12275 | 78 | Peewit Liver | 0.02 | a | 0.01 | b |
| 12276 | | Muscle | 0.01 | a | a | b |
| 12277 | 79 | Banded Plover Liver | a | a | 0.01 | b |
| 12278 | | Muscle | a | a | a | b |
| 12279 | 80 | Magpie Liver | 0.02 | a | 0.02 | 0.01 |
| 12280 | | Muscle | a | a | a | 0.01 |
| 12281 | 81 | Banded Plover Liver | a | a | 0.01 | b |
| 12282 | | Muscle | a | a | a | 0.01 |
| 12283 | 82 | Banded Plover Liver | 0.01 | a | 0.01 | 0.01 |
| 12284 | | Muscle | 0.01 | 0.01 | a | 0.02 |
| 12285 | 83 | Banded Plover Liver | a | a | 0.01 | 0.01 |
| 12286 | | Muscle | a | a | a | 0.03 |

./2.

| Lab. No. (1971) | Sample No. | Marks | D.D.E. | D.D.T. | Dieldrin | H.C.E. |
|---|---|---|---|---|---|---|
| | | | parts per million | | | |
| 12287 | 84 | Banded Plover Liver | a | a | 0.01 | b |
| 12288 | | Muscle | a | a | 0.01 | 0.02 |
| 12289 | 85 | Peewit Liver | 0.16 | 0.01 | 0.08 | 0.12 |
| 12290 | | Muscle | 0.02 | a | a | 0.04 |
| 12291 | 86 | Pied Butcher Bird Liver | 0.06 | 0.01 | 0.02 | 0.02 |
| 12292 | | Muscle | 0.01 | a | a | 0.01 |
| 12293 | 87 | Banded Plover Liver | 0.02 | 0.01 | 0.01 | a |
| 12294 | | Muscle | 0.01 | 0.01 | 0.01 | a |
| 12295 | 88 | Brown Song-lark Liver | 0.01 | 0.01 | 0.03 | 0.01 |
| 12296 | | Muscle | a | a | a | a |
| 12297 | 89 | Brown Song-lark Liver | 0.01 | 0.01 | 0.01 | 0.01 |
| 12298 | | Muscle | a | a | a | a |
| 12299 | 90 | Banded Plover Liver | 0.04 | 0.01 | a | 0.01 |
| 12300 | | Muscle | 0.02 | 0.01 | a | a |
| 12301 | 91 | Brown Song-lark Liver | 0.01 | 0.01 | 0.01 | 0.02 |
| 12302 | | Muscle | a | a | a | 0.01 |
| 12303 | 92 | Brown Song-lark Liver | 0.01 | 0.01 | 0.02 | a |
| 12304 | | Muscle | a | a | a | a |

Analysis of samples of brain tissue:

Due to the small size of each individual sample of brain tissue submitted for analysis, these tissues were bulked according to species as follows:-

| Lab. No. (1971) | Sample No. | Marks | D.D.E. | D.D.T. | Dieldrin | H.C.B. |
|---|---|---|---|---|---|---|
| | | | parts per million | | | |
| 12305-07 | 75, 76, 80 | Magpie Brain | a | a | a | b |
| 12308-10 | 77, 78, 85 | Peewit Brain | 0.01 | a | 0.01 | 0.03 |
| 12311-17 | 79, 81, 82, 83, 84, 87, 90 | Banded Plover Brain | a | a | a | a |
| 12318-21 | 88, 89, 91, 92 | Brown Song-lark Brain | a | a | a | 0.01 |
| 12322 | 74 | Crested Pigeon Brain | Insufficient sample, not analysed | | | |
| 12323 | 86 | Pied Butcher Bird Brain | Insufficient sample, not analysed | | | |

./3.

a = less than 0.01 parts per million.

b = not detected. Limit of detection: 0.001 parts per million.

No organo-phosphate insecticides were detected in any of the above samples.

The limit of detection for maldison was 0.001 parts per million.

G.P. EBELL,
A.M. STENHOUSE,
CHEMISTS.

N.R. HOUGHTON,
DIVISIONAL CHIEF,
FOODS, DRUGS & TOXICOLOGY.

O.H.M.S.

RUTHERFORD

enquiry 1987

Dr R Prance
CALM
WOODVALE

DEPARTMENT OF
CONSERVATION AND
LAND MANAGEMENT

rel. typed draft,

Magpie paper.

Rec'd from Pete Rutherford in Discussion 1400 – 1500 hrs 9/6/87

RITP + S. Halse

PROPOSED CONSULTANCY IN AGRICULTURAL CHEMICALS - ENVIRONMENTAL PROTECTION AUTHORITY

Terms of reference:

To develop and recommend on short and long-term action plans for management of the environmental impact of agricultural chemicals

(1) by utilizing appropriate conclusions and listed contacts in the report prepared by Mrs Catherine Jefferson, Consultant in 1985, as a starting point, and

(2) following a review of the current Western Australian situation.

Consideration will need to be given to the following, amongst others:-

- desirable management practices
- appropriate agencies for management and control
- monitoring of effects
- amelioration of impact
- assessment of impact
- utilization of alternatives
- overspraying and effect upon native flora and fauna
- (bio) accumulation
- modes of application
- legislative requirements
- identification of problem areas
- liaison with relevant government agencies, industry (including users), academia, industry and professional associations (PIA etc), community groups (Pesticide Action Group, etc) and others.

(3) A written report to be completed within three months of the commencement of the consultancy.

ENVIRONMENTAL PROTECTION AUTHORITY

ENVIRONMENTAL IMPACT OF PESTICIDES

PUBLIC SUBMISSIONS INVITED

Mr Peter Rutherford, the Pesticide Co-ordinator of the Department of Agriculture, has been asked by the Ministers for the Environment and for Agriculture to conduct a study into the environmental impact of pesticides. The study will be completed by the end of August 1987.

Specifically, Mr Rutherford will review current use-patterns of pesticides in Western Australia, together with a review of existing environmental monitoring programmes. He will make recommendations on improvements to pesticide monitoring programmes which will allow better management of the environmental impact of pesticides.

Members of the public are invited to make relevant submissions to Mr Rutherford. He can be contacted by telephone on 09 222 7008, or in writing to the Environmental Protection Authority, 1 Mount Street, Perth, W.A. 6000.

Submissions should reach Mr Rutherford by Friday 26 June 1987.

ENVIRONMENTAL PROTECTION AUTHORITY
1 MOUNT STREET, PERTH, WESTERN AUSTRALIA 6000
Telephone (09) 222 7000

Your Ref:
Our Ref:
Enquiries:

AGRICULTURAL CHEMICALS - EPA STUDY

You will no doubt be aware, from the media statement issued recently by the Hon Minister for the Environment (copy attached), that the Environmental Protection Authority has commissioned a study into the environmental impact of agricultural chemicals.

Details of the study have been finalised, and I wish to advise you of my secondment from the Department of Agriculture to the EPA to conduct the study. The length of consultancy is three months, commencing on Tuesday 2 June 1987.

I have attached a copy of the objectives and criteria of the study for your information. You will also notice, from the attached copy, that public submissions have been called.

I would be grateful for any written submissions you may wish to make to the study, preferably by the deadline of Friday 26 June 1987.

Thank you for your cooperation and assistance.

Yours faithfully

Peter Rutherford

P A RUTHERFORD
CONSULTANT.

enc

Copied to Peter Rutherford 23/6/87

D R A F T

ROBERT I.T. PRINCE

# PESTICIDE RESIDUES IN WESTERN AUSTRALIAN WILDLIFE

## 1. Organochlorine residues in the Western Magpie (Gymnorhina dorsalis) in the south west.

### Introduction

The organochlorine or chlorinated hydrocarbon insecticides, of which DDT is perhaps the best known, have in the recent past been of great benefit to public health authorities and to agricultural industries throughout the world because of their ability to kill a wide range of insect pests, their commonly low acute toxicity to mammals, and the ease with which they could be extensively distributed and applied (refs ). Increasing tolerance acquired by many of the target insect pests with the passage time reduced the initial effectiveness of DDT as an insecticide, leading firstly to the need for increased rates of application to achieve the same levels of control and eventually to replacement of, or substitution for DDT in many cases with a new suite of synthetic insecticides, including additional members of the family of chlorinated hydrocarbons e.g. dieldrin, aldrin, endrin, etc., and the often more toxic organophosphates (refs ).

Following the early euphoric publicity of the direct benefits occurring from the use of DDT it became clear that contamination of foodstuffs was still a potential public hazard. It also soon became clear that DDT and its chemical relatives posed chronic hazards to wildlife and had the capacity to permeate food chains far removed from the site of application (refs ). One of the better known side effects attributable to penetration of food chains by DDT and related chemicals is the phenomenon of egg-shell thinning affecting populations of top order avian predators

such as the Osprey (Pandion haliaetus) and Peregrine Falcon (Falco peregrinus) (refs ).

DDT, dieldrin, and other chlorinated hydrocarbon insecticides were being used in Western Australia during the early 1970s (e.g. refs ) but no specific data on either the quantities being used or the pattern of distribution of use within the state could be obtained. There were also no data on the probable accumulation of residues of these insecticides in any indigenous wildlife species. A pilot study to assess the general penetration of residues into local food chains and the presumed affects of differing levels of use of DDT and dieldrin in particular was commenced in south western Western Australia in December 1970.

## Materials and Methods

### Study Area

The study was focussed on the south western corner of the state where the majority of the human population lives and where the longest history of continued insecticide usage for protection of household gardens, horticultural crops, irrigated pastures and dryland cereal crops could be expected. The majority of the collecting required was concentrated within the area bounded by the west coast and a line from Perth to Albany (Fig. 1.). The region generally experiences a pronounced Mediterranean climate with hot dry summers and cool wet winters (ref ). Annual rainfall varies from as much as 1400 mm per annum on parts of the south coast, and in a small area on the western edge of the Darling Scarp to the south east of Perth, to as little as 400 mm per annum in the dryland farming areas at the eastern inland boundary of the study area. _____ percent of the annual average rainfall is received between the months of _____ and _____ (ref ). The major growing period for annual crops and pastures is _____ (ref ).

Sampling

The Western Magpie (Gymnorhina dorsalis) was selected as the indicator species for assessing contamination of the terrestrial environment because this relatively large (length, weight) passerine is widespread and numerous throughout the south west, predominantly insectivorous, long-lived (to 9 years in the field), sedentary and territorial (family groups holding territories of c. 10-100 ha.), and can readily be aged (refs ). These birds can also be easily kept in captivity.

Birds required were selected from among their family groups and shot using a .410 shotgun [with no. 4 shot?]. Relevant collection details were usually recorded in the field. Fresh tissue samples were taken by opening the carcase along the ventral mid-line. Pectoral muscles were then separated from the body and placed in labelled containers supplied by the Western Australian Government Chemical Laboratories.

Livers were also dissected out and treated similarly. The separate containers with these individual liver and muscle samples were then frozen by contact with dry ice and maintained in this way for transport back to the laboratory. This was the preferred method of sampling. Frozen samples as collected were held in a deep freeze prior to processing for residue analyses.

Where field processing was not possible the collectors were instructed to freeze the birds taken as soon as possible after death, and to then arrange for the still frozen birds to be forwarded to the Wildlife Research Centre. Birds collected in this manner were held in deep freeze until sampling. At this point the carcases were thawed to facilitate dissection and pectoral muscle and liver samples taken as described previously for fresh shot birds. These tissue samples were also refrozen for holding prior to residue analysis.

Liver and pectoral muscle were the only tissues of sufficient mass to permit individual analyses. Other tissues were generally not sampled because of this restriction.

## Analyses

Glass containers used for collection and storage of tissue samples were pre-washed with to prevent contamination of samples. Tissue samples for analyses were thawed extracted etc. Analysis using according to the method of (refs. Geoff Ebell).

## Results

One hundred and fourteen Western Magpies (Gymnorhina dorsalis) were collected between December 1970 and mid-April 1973 when the collecting programme was terminated. The majority (70) of these birds were collected and field sampled within the Perth-Albany-Cape Naturaliste triangle (lower south west) during June-July 1971. The additional 44 birds were obtained from a number of other sources as detailed below.

One of the 19 birds obtained for sampling from within the urban section of the Perth Metropolitan Area was collected in December 1971 by an amateur gardener who had seen the bird collapse and then die and was worried that insecticides and nematocides he had used may have been implicated in the bird's death. The other 18 were aggressive birds shot by state Fauna Wardens (now Wildlife Officers) in order to protect the public from injury. All but one of these was taken during October-November 1972. The remaining bird was taken in April 1973.

A further 8 birds were taken in the Pinjarra-Mandurah district during the period December 1970 through February 1971, and another six from the areas north of Perth, three from different sites in December 1970 and another three from

the Mingenew district in August 1971. The mixed orchard and forest area in the hills to the east of Perth provided 8 more birds in February 1972. The remaining three birds included two shot by Fauna Wardens, and one other taken by wildlife research staff. Due to oversight, samples from four of the birds from the Perth urban area were not passed on for analysis. Data for the 110 birds submitted for residue analyses are summarized in Table 1.

TABLE 1

North of Perth

| Bird Sample No | Date Collected | Collecting Locality | Sex | Age Class | Body Weight | Length | Habitat type | Liver DDT & metabs | Liver Dieldrin | Muscle DDT | Muscle Dieldrin |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 75 | 8/71 | Mingenew | ♂ | 2+ | 315g | 42.0cm | Farmland | 0.01+ | 0.01 | a | a |
| 76 | 8/71 | Mingenew | ♂ | 2+ | 275g | 40.5cm | Farmland | 0.03 | 0.01 | 0.01+ | a |
| 80 | 8/71 | Mingenew | ♂ | 1+ | 275g | 42.0cm | Farmland | 0.02+ | 0.02 | a | a |
| ? | 12/70 | Marchagee | ? | ? | ? | ? | Farmland | 0.02+ | <0.01 | 0.01 | <0.01 |
| ? | 12/70 | Watheroo | ? | ? | ? | ? | Farmland | No sample | | 0.03 | 0.02 |
| ? | 12/70 | Guilderton | ? | ? | ? | ? | Farmland | 0.02 | 0.43 | 0.01+ | 0.11 |

Perth urban area

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Donnelly Bird 123 | 12/71 | Claremont | ? | ? | ? | ? | Home Garden | 12.0 | 19.0 | 9.6 | 13.0 |
| | 10/72 | Metro area | ♂ | Adult (Whiteback) | [355g] | 41.0cm | Urban | 2.0 | 1.7 | 0.4 | 0.3 |
| 126 | 10/72 | Como | ♂ | Adult [4+] | [350g] | 43.0cm | Urban | 3.2 | 1.0 | 0.9 | 0.2 |
| 129 | 10/72 | Morley | ♂ | Adult [4+] | [325g] | 40.0cm | Urban ?[fringe] | 1.2 | 1.5 | 0.4 | 0.2 |
| 134 | 10/72 | Como (Prob ♀, RP) | ?? | ?1+ | [375g] | 44.0cm | Urban | No sample | | [4.2 | 3.2] |
| 140 | 10/72 | Willetton? | ? | 2+ | [245g] | 41.5cm | Urban | ?33.0 | 12.0 | 2.3 | 1.1 |
| 141 | 10/72 | Viveash | ♂ | Adult [3+] | [355g] | 40.7cm | Urban fringe | 1.7 | 0.2 | 0.4 | 0.1 |
| 143 | 10/72 | Viveash | ♂ | 1+ | [340g] | 39.5cm | Urban fringe | 1.7 | 0.2 | 0.3 | 0.03 |
| 142 | 10/72 | Metro area | ♂ | Adult | [340g] | 38.0cm | ?Urban fringe | 0.5 | 0.5 | 0.3 | 0.2 |
| 144 | 10/72 | North Beach | ♂ | Adult | [330g] | 39.0cm | Urban | 3.8 | 2.2 | 1.2 | 0.3 |
| 145 | 10/72 | Morley | ♂ | Adult | [375g] | 42.0cm | Urban fringe | 0.6 | 0.2 | 0.4 | 0.1 |
| 146 | 10/72 | Balga | ♂ | Adult | [335g] | 43.5cm | Urban fringe | 0.5 | 0.3 | 0.4 | 0.1 |
| 125 | 11/72 | Metro area | ♀ | 2+ | [355g] | 40.0cm | Urban | 3.4 | 3.4 | 0.4 | 0.5 |
| 128 | 11/72 | Cloverdale | ♂ | 1+ | [285g] | 37.0cm | Urban | 1.7 | 1.7 | 0.4 | 0.4 |

| | | | | | | | | Liver | | Muscle | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 122 | 4/73 | Scarborough | ♂ | Adult | [325g] | 42.5cm | Urban (fringe) | 0.02 | 0.01 | 0.02 | <<0.01 |
| **Orchards and Forest: Area E of Perth** | | | | | | | | | | | |
| 1 | 6/71 | ⎫ Pickering Brook | ♂ | 0+ | ? | 42.0cm | Forest | 0.61 | 0.04 | 0.35 | 0.01 |
| 2 | 6/71 | ⎭ Pickering Brook | ♀ | 1+ | ? | 39.5cm | Forest | 1.93 | 0.03 | 0.75 | 0.01 |
| 111 | 2/72 | ⎫ Karragullen | ♂ | 0+ | 295g | 40.5cm | Orchards | 3.6 | 1.8 | 0.8 | 0.3 |
| 112 | 2/72 | ⎭ Karragullen | ♂ | 1+ | 305g | 42.0cm | Orchards | 6.8 | 1.1 | 3.8 | 0.6 |
| 113 | 2/72 | Pickering Brook | ♂ | >4 yrs | 330g | 43.0cm | Orchards | 9.8 | 0.4 | 3.8 | 0.4 |
| 114 | 2/72 | Pickering Brook | ♀ | 1+ | 290g | 39.5cm | Orchards | 0.2 | 0.06 | 0.2 | 0.03 |
| 115 | 2/72 | ⎫ Hacketts Gully | ♂ | 2+ | 295g | 39.5cm | Orchards | 25.0 | 0.18 | 9.0 | 0.01 |
| 116 | 2/72 | ⎭ Hacketts Gully | ♀ | 1+ | 265g | 40.5cm | Orchards | 1.7 | 0.1 | 1.2 | 0.02 |
| 117 | 2/72 | Mundaring Weir | ♂ | 0+ | 295g | 43.0cm | Forest/Orchard | 0.5 | 0.1 | 0.3 | 0.01 |
| 118 | 2/72 | Pickering Brook | ♂ | >>4 yrs | 335g | 42.5cm | Orchard | 8.2 | 0.05 | 14.0 | 0.1† |
| **Armadale-Serpentine** | | | | | | | | | | | |
| 67 | 7/71 | Armadale | ♂ | 2+ | 285g | 41.5cm | Pasture | 0.1 | 0.4 | 0.04 | 0.03 |
| 68 | 7/71 | Armadale | ♀ | 2+ | 265g | 38.5cm | Pasture | 1.2 | 0.5 | 0.3 | 0.07 |
| 69 | 7/71 | ⎫ Byford | ♂ | >4 | 270g | 43.0cm | P | 0.01 | 0.01 | <0.01 | <<0.01 |
| 70 | 7/71 | ⎭ Byford | ♀ | 2+ | 320g | 41.5cm | P | 0.03 | 0.02 | 0.01 | <<0.01 |
| 73 | 7/71 | Serpentine | ♂ | 3+ | 308g | 38.5cm | P | 0.07 | 0.01 | 0.03 | <<0.01 |
| 110(136) | 2/72 | Serpentine | ♀ | 2+ | 260g | 37.5cm | P | 0.01 | 0.01 | 0.05 | <0.01 |
| 147 | 10/72 | Byford | ♂ | Adult | [300g] | 39.5cm | Townsite | 0.2 | 0.05 | 0.08 | 0.02 |
| **Keysbrook-Dwellingup-Pinjarra-Mandurah-Waroona** | | | | | | | | | | | |
| γ | 12/70 | Greensland Rd, Pinjarra | ? | ? | ? | ? | P | 0.01 | <0.01 | <0.01 | <<0.01 |
| 120 | 2/71 | Greensland Rd, Pinjarra | ? | 0+? | [285g] | 38.5cm | P | 0.01 | 0.01 | <0.01 | <<0.01 |
| β | 12/70 | Robert Bay, Peel Inlet | ? | ? | ? | ? | P | 0.01+ | <<0.01 | <0.01 | <<0.002 |

| | | | | | | | | Liver | | Muscle | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 119 | 2/71 | Heron Point area, Harvey Estuary | ♂ | 2+ | [335g] | 42.0cm | P | 0.02 | 0.02 | <0.01 | <<0.01 |
| ∝ | 12/70 | SE Corner, Harvey Estuary | ? | ? | ? | ? | P | 0.18 | 0.01 | 0.05+ | <<0.01 |
| Y | 2/71 | Mandurah district | ? | ? | ? | ? | P | 0.04 | 0.04 | 0.01+ | a [<<0.01] |
| 121 | 2/71 | Mandurah district | ♂ | 3+ | [370g] | 41.5cm | P | <0.01 | 0.01 | <0.01 | <<0.01 |
| × | 12/70 | Lakeside area, Mandurah district | ? | ? | ? | ? | P | 0.02 | 0.01 | 0.02 | 0.01 |
| 3 | 7/71 | Pinjarra | ♂ | >4 | 290 | 39.5cm | P | 0.08 | 0.02 | 0.02+ | 0.01 |
| 5 | 7/71 | Waroona | ♂ | >4 | 290 | 42.0cm | P | 0.32 | 0.02 | 0.08 | 0.01 |
| 6 | 7/71 | Waroona | ♀ | 4 | 290 | 40.5cm | P | 0.04 | 0.01 | 0.01+ | <0.01 |
| 8 | 7/71 | Yarloop | ♂ | 5 | 325 | 42.5cm | P | 0.02+ | 0.01 | 0.01+ | <0.01 |
| 65 | 7/71 | Isandra (Dwellingup) | ♂ | 2+ | 300 | 39.0cm | P | 0.01 | <0.01 | 0.02 | <<0.01 |
| 66 | 7/71 | Coolup | ♂ | 1+ | 295 | 41.0cm | P/B | <0.01 | <0.01 | <<0.01 | <<0.01 |
| 71 | 7/71 | North Dandalup | ♂ | >4 | 303 | 42.5cm | P | 0.06 | 0.02 | 0.01 | <0.01 |
| 72 | 7/71 | North Dandalup | ♂ | 2+ | 305 | 43.5cm | P | 0.06 | 0.03 | 0.02 | 0.01 |
| **Waterloo-Dardanup-Capel** | | | | | | | | | | | |
| 10 | 7/71 | Waterloo | ♀ | 2+ | 290 | 39.5cm | Pi | 0.06 | 0.02 | 0.02 | <0.01 |
| 11 | 7/71 | Dardanup | ♂ | <4 | 325 | 42.5cm | Pi | 0.07 | 0.03 | 0.05 | <0.01 |
| 12 | 7/71 | Dardanup | ♀ | 2+ | 310g | 39.5cm | P/b | 0.05 | 0.02 | 0.05 | 0.02 |
| 19 | 7/71 | Capel | ♂ | 2+ | 290g | 41.5cm | P | 0.01+ | 0.01 | <0.01 | <0.001 |
| 139 | 10/72 | Capel | ♂ | Adult (>4) | [360g] | 42.0cm | Townsite | 0.02 | 0.01 | 0.01 | <0.01 |
| **Donnybrook District** | | | | | | | | | | | |
| 16 | 7/71 | Lowden | ♂ | ≥5+ | 295g | 41.0cm | P | 0.41 | 0.22 | 0.16 | 0.03 |
| 17 | 7/71 | Donnybrook | ♀ | 2+ | 295g | 41.0cm | P/Orchard | 1.80 | 0.60 | 0.90 | 0.30 |
| 18 | 7/71 | ~15 km SW of Donnybrook | ♂ | 2+ | 260g | 41.0cm | P | 0.19 | 0.10 | 0.06 | <0.01 |
| **Busselton-Augusta** | | | | | | | | | | | |

| | | | | | | | | Liver | | Muscle | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 7/71 | Busselton | ♀ | 0+ | 270g | 39.5cm | P | <0.01 | 0.03 | <<0.01 | 0.01 |
| 21 | 7/71 | Carbunup or Marybrook | ♂ | 0+ | 310g | 41.5cm | P | 0.16 | 0.30 | 0.05 | 0.10 |
| 22 | 7/71 | Carbunup or Marybrook | ♂ | >4 | 310g | 42.0cm | P | 0.28 | 0.08 | 0.13 | 0.03 |
| 23 | 7/71 | Yallingup | ♂ | 0+ | 280g | 41.5cm | Forest | 0.03 | 0.10 | 0.01+ | 0.02 |
| 24 | 7/71 | Yallingup | ♀ | 2+ | 335g | 40.5cm | P/F | 0.04 | 0.08 | 0.03 | 0.02 |
| 25 | 7/71 | Mammoth Cave | ♀ | 2+ | 315g | 42.0cm | Forest | 0.05 | 0.02 | 0.03 | 0.01 |
| 26 | 7/71 | Mammoth Cave | ♂ | 2+ | 315g | 43.0cm | Forest | 0.08 | 0.02 | 0.04 | 0.01 |
| 27 | 7/71 | Alexandra Bridge | ♂ | >4 | 300g | 43.0cm | P/F ? | 0.04 | 0.03 | 0.04 | 0.02 |
| **Nannup-Mullalyup-Boyup Brook-Manjimup-Pemberton** | | | | | | | | | | | |
| 28 | 7/71 | Nannup | ♀ | ≥2+ | 300g | 39.5cm | P/F | 6.82 | 3.1 | 3.4 | 1.5 |
| 29 | 7/71 | W of Bridgetown | ♀ | 1+ | 240g | 39.5cm | P | 0.03 | 0.01 | 0.04 | 0.01 |
| 30 | 7/71 | W of Bridgetown | ♀ | 4+ | 300g | 41.0cm | P | 0.10 | 0.01 | 0.05 | 0.01 |
| 31 | 7/71 | Balingup | ♂ | >4 | 305g | 40.5cm | P/F | 0.13 | 0.04 | 0.03 | 0.01 |
| 32 | 7/71 | W of Boyup Brook | ♂ | 4+ | 315g | 42.0cm | P | 0.02 | 0.14 | 0.03 | 0.03 |
| 33 | 7/71 | W of Boyup Brook | ♂ | ≥5+ | 265g | 40.5cm | P | 0.54 | 0.16 | 0.15 | 0.04 |
| 34 | 7/71 | Palgarup | ♂ | >4 | 320g | 41.0cm | Townsite | 0.13 | 0.14 | 0.04 | 0.02 |
| 35 | 7/71 | Palgarup | ♀ | 3+ | 260g | 38.0cm | Townsite | 0.06 | 0.14 | 0.02 | 0.07 |
| 36 | 7/71 | Pemberton | ♂ | 1+ | 280g | 38.0cm | Townsite | 1.25 | 0.05 | 0.27 | 0.01 |
| 37 | 7/71 | Pemberton | ♂ | >4 | 265g | 41.5cm | P/F | 0.70 | 1.00 | 0.10 | 0.10 |
| **Mt Barker-Denmark-Albany** | | | | | | | | | | | |
| 38 | 7/71 | SW of Mt Barker | ♂ | >4 | 340g | 42.0cm | P/B | 0.06 | 0.02 | 0.04 | <0.01 |
| 39 | 7/71 | SW of Mt Barker | ♂ | 1+ | 305g | 40.5cm | P/B | 0.05 | 0.20 | 0.04 | 0.01 |
| 40 | 7/71 | Mt Barker | ♂ | 1+ | 295g | 42.0cm | P/B | 0.10 | 0.04 | 0.05 | 0.01 |
| 41 | 7/71 | Albany nr Airstrip | ♂ | 2+ | 320g | 42.5cm | P | 0.08 | 0.01 | 0.06 | 0.01 |
| 42 | 7/71 | Bornholm | ♂ | >4 | 335g | 43.0cm | P | 0.20 | 0.10 | 0.05 | <0.01 |
| 43 | 7/71 | Bornholm | ♂ | >4 | 305g | 43.5cm | P/B | 0.30 | 0.10 | 0.09 | <0.01 |
| 44 | 7/71 | Kendenup | ♂ | >4 | 305g | 43.0cm | P/B | 0.40 | 0.05 | 0.20 | <0.01 |
| 45 | 7/71 | Kendenup | ♂ | >4 | 315g | 43.0cm | P/B | 0.20 | 0.02 | 0.20 | <0.01 |

| | | | | | | | | Liver | | Muscle | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Qualeup-Frankland-Rocky Gully** | | | | | | | | | | | |
| 46 | 7/71 | W of Cranbrook | ♂ | 1+ | 305g | 40.5cm | P | 0.06 | 0.02 | 0.10 | 0.01 |
| 47 | 7/71 | Rocky Gully | ♀ | 1+ | 305g | 41.0cm | P | 0.04 | <0.01 | 0.05 | <0.01 |
| 48 | 7/71 | Rocky Gully | ♂ | 1+ | 290g | 40.5cm | P | 0.04 | <0.01 | 0.06 | <0.01 |
| 49 | 7/71 | Frankland | ♂ | >4 | 300g | 42.0cm | P | 0.20 | <0.01 | 0.10 | <0.01 |
| 50 | 7/71 | Riversdale | ♂ | >4 | 285g | 41.5cm | P | 0.04 | <0.01 | 0.02 | <0.01 |
| 51 | 7/71 | E of Mobrup | ♂ | 2+ | 315g | 40.5cm | P/B | 0.02 | <0.01 | 0.02 | <0.01 |
| 52 | 7/71 | W of Jingalup | ♂ | 1+ | 305g | 38.0cm | P | 0.10 | <0.01 | 0.04 | <0.01 |
| 53 | 7/71 | Narlingup | ♂ | >4 | 360g | 43.5cm | P | 0.05 | <0.01 | 0.01 | <0.01 |
| **Mumballup-Collie-Darkan-Duranillin** | | | | | | | | | | | |
| 15 | 7/71 | Glen Mervyn | ♂ | >4 | 350g | 41.5cm | P | 0.01+ | 0.01 | <0.01 | <0.01 |
| 14 | 7/71 | Cardiff | ♂ | >4 | 280g | 41.5cm | Forest | 0.09+ | 0.02 | 0.05+ | 0.01 |
| 13 | 7/71 | Collie | ♂ | >4 | 290g | 43.5cm | Townsite | 0.02 | 0.02 | 0.01+ | <0.01 |
| 54 | 7/71 | Capercup | ♂ | 1+ | 305g | 40.5cm | P | 0.10 | 0.02 | 0.04 | <<0.01 |
| 55 | 7/71 | Muja | ♂ | >4 | 340g | 43.0cm | P | 0.02 | <<0.01 | <0.01 | <<0.01 |
| 56 | 7/71 | Bowelling | ♀ | 2+ | 290g | 40.5cm | P | 0.01 | <<0.01 | <0.01 | <<0.01 |
| 57 | 7/71 | Boolading | ♀ | 2+ | 300g | 40.5cm | P | 0.01 | <<0.01 | 0.01 | <<0.01 |
| 58 | 7/71 | Darkan | ♂ | 6+ | 355g | 42.0cm | P | 0.02 | <0.01 | 0.01 | <<0.01 |
| **Williams-Boddington** | | | | | | | | | | | |
| 59 | 7/71 | Williams | ♂ | >5 | 310g | 41.5cm | P | 0.01 | 0.01 | 0.01 | <<0.01 |
| 60 | 7/71 | SW of Williams | ♂ | 1+ | 250g | 39.5cm | P | 0.10 | <<0.01 | 0.03 | <<0.01 |
| 61 | 7/71 | Quindanning | ♀ | ≥3+ | 315g | 41.0cm | P | <0.01 | <<0.01 | <0.01 | <<0.01 |
| 62 | 7/71 | S of Boddington | ♂ | 2+ | 300g | 42.5cm | P/B | <0.01 | <<0.01 | <0.01 | <<0.01 |
| 63 | 7/71 | SW of Boddington | ♂ | <5 | 295g | 42.5cm | P/B | <0.01 | <<0.01 | <<0.01 | <<0.01 |
| 64 | 7/71 | SW of Boddington | ♂ | 2+ | 295g | 41.5cm | P/B | <0.01 | <<0.01 | <0.01 | <<0.01 |

## North of Perth

6 Birds — all livers ≤ 0.05 ppm DDT + metabs

3 yng ♂♂ Dieldrin generally ≡ DDT + metabs

others ?? but 1 bird dieldrin most abundant residue at 0.4 ppm — Guilderton.

## Metro Area

15 Birds

| | | DDT+ | Diel |
|---|---|---|---|
| 2 relatively high — Claremont | L | 12. | 19. |
| Willetton | L | 33. | 12. |

8 — range 1. to 4.

4 < 1.0 ; 3 around 0.6

1 0.02 — similar to background levels in rural country areas

no correlation here; with age class the highest was 2+ ♂ — application rates vary widely in home gardens

## Orchard areas

10 birds — 2 winter, 8 summer.

(25 ppm)

The highest conc DDT+ in one 2+ ♀ ever best apart from this the 2 next highest concs (8–10 ppm DDT+ were found in aged ♂♂



only 2 samples < 1.0 ppm this group — these both in young birds (0+, 1+) on the fringe of orchards.

Application rate again (and season of application.

## Armadale Serpentine

8 birds — mainly younger birds most winter all except 1 with residues ≤ 0.2 ppm DDT and only 2 with dieldrin ≥ 0.4 ppm. these exceptn both Armadale district — reasons? — maybe pasture spray or access to home gardens.

## Keysbrook etc

16 birds { 8 summer 70/71 ; 8 winter 71

all except 2 < 0.10 DDT with dieldrin < 0.05 in all cases

the two exceptns re DDT both < 0.5 ppm

no other analysis possible.

## Waterloo etc

5 birds — all < 0.1 DDT + 0.05 Dieldrin.

no other analysis possible

Apart from the Nanaimo Bird, the only DDT + and/or Dieldrin concentrations ≥ 1 ppm found outside the Park Metro area are:

1 Domingbrook orchard: 1.80 DDT

{ 1 Parkerton district 1.00 Dieldrin.
{ [1 Armadale district 1.2 DDT

Map General sampling distn.

these "high" conc samples.



Busselton - Augusta

8 birds majority young; 6 ≤ 2+ plus 2 adult ♂♂

two above 0.1 ppm DDT with one of these having 0.3 dieldrin - all the rest have ≤ 0.1 ppm dieldrin

cover from pasture sprays it seems

Nanaimo - Mullalyup - Busselton

10 birds range young to old (1+ to ≥ 5+)

all except two are ≤ 1.0 ppm DDT + & ≤ 1.0 ppm DDT + Dieldrin - one bird - 2+ ♀ call near Nanaimo townsite (1 mile) 6.8 + 3.1

the next highest DDT 1.25 in one Parkerton 1+ ♂ & a 2nd Parkerton >4 ♂ has 1.00 dieldrin.

* { The Nanaimo Bird has ≥ conc DDT than all except 6 Metro & E. Hills orchard Birds and > Dieldrin than all except 2 metro area Birds

Thus source of contamination here perhaps also a zealous gardener.

only substantially less than 2 Metro Birds for both DDT + Dieldrin + 1 orchard DDT only

DDE / DDT + metabs Ratios

45 birds results reported

DDE > DDT repeatedly

majority of cases (27) DDE ≥ 75% of the DDT + metabs determined — in 1/2 of these the ratio exceeded 85%.

Those with DDT ≥ DDE as determined generally @ low levels near limits of detection of analyses. But apart from these there was one small group of 6 samples where ratios of DDE/DDT + metabs were very low in comparison with the rest of the samples considered. The "totals" for this group were generally low, but in comparison also with the other samples considered this latter group was distinguished by the presence of traces of Indane in the samples as well as the usual DDT etc plus dieldrin — assume pasture spraying use

Limits of detection usually 0.001 ppm

Other data

DDE / DDT

| | | | | | |
|---|---|---|---|---|---|
| Donnelly | DDE | L 12.0 | DDT negligible | >.99 | |
| 1 | | L 0.57 | 0.04 | 0.934 | |
| 2 | | L 1.90 | 0.03 | 0.984 | |
| 3 | | L 0.73 | | 0.875 | |
| 5 | | L 0.30 | | 0.938 | |
| 6 | | L 0.03 | | 0.750 | |
| 8 | | L 0.02 | | 0.900 | |
| 10 | | L 0.05 | | 0.833 | |
| 11 | | L 0.06 | | 0.857 | |
| 12 | | L 0.04 | | 0.800 | |
| ? x 13 | | L 0.01 | | 0.500 | |
| 14 | | L 0.08 | | 0.889 | |
| ? x 15 | | L<0.01 | | <0.5 | |
| 16 | | L 0.40 | | 0.975 | |
| * | | | | | No other data reported |
| 18 | | L 0.17 | | 0.895 | |
| 19 | | L 0.01 | | ≥0.80 | |
| 20 | | L <0.01 | | ~0.50 | |
| 21 | | L 0.14 | | 0.875 | |

| | | | |
|---|---|---|---|
| * 22 | L 0.08 | 0.956 | Lindane det |
| ? x 23 | L 0.01 | 0.333 | ✓ |
| ? x 24 | L 0.02 | 0.500 | |
| ? x 25 | L 0.01 | 0.200 | ✓ |
| ? x 26 | L 0.02 | 0.250 | ✓ |
| ? x 27 | L 0.02 | 0.50 | |
| 28 | L 6.2 | 0.909 | No lindane |
| ? x 29 | L 0.01 | 0.333 | ✓ |
| 30 | L 0.08 | 0.800 | No lindane |
| 31 | L 0.11 | 0.846 | No lindane |
| ? x 32 | L 0.01 | 0.500 | |
| * 33 | L 0.14 | 0.769 | Lindane det |
| 34 | L 0.10 | 0.769 | trace lindane and |
| 35 | L 0.04 | .667 | do |
| 36 | L 1.00 | 0.800 | No lindane |
| γ | L 0.01 | 0.949 . | |
| β | L 0.009 | 0.818 . | |
| α | L 0.17 | 0.950 . | |
| C | L 0.019 | 0.886 . | |
| B | L 0.018 | 0.667 . | |
| A | L 0.08 | ~0.500 . | |
| 8403-4 | L 0.01 | 0.500 | |
| 8405-6 | L 0.03 | 0.750 | |
| 75 | L 0.01 | ≥ 0.800 | |
| 76 | L 0.03 | 0.667 | |
| 80 | L 0.03 | ≥ 0.900 | |

Many of these samples had other chlorinated hydrocarbons

♂♂

| # | Age | Wt | L | Tail Black Band | Number of white facial feathers | | |
|---|---|---|---|---|---|---|---|
| 3 | >4 | 290 | 39.5 | 1" | No white | | |
| 5 | >4 | 290 | 42.0 | 1½" | 2 of 3 ½" White | | |
| 8 | ≥4+ | 325 | 42.5 | 1" | 2 of 3 with white | * Bk + Buff | |
| 11 | >4 | 325 | 42.5 | 1" | 2 of 3 " " | | |
| 13 | >4 | 290 | 44.0 | 1" | 2 of 3 " " | * Bk + Buff | |
| 14 | >4 | 280 | 41.5 | 1" | | | |
| 15 | >4 | 350 | 41.5 | 1" | 2 of 3 " " | * Bk | |
| 16 | ≥5 | 295 | 41.5 | 1" | 2 of 3 " " | * Bk + Buff | |
| 18 | 2+ | 260 | 41.5 | 1½" | 2 of 3 " " | * Buff, wing | |
| 19 | 2+ | 290 | 41.5 | 1½" | 2 of 3 " " | Bk + Buff | |
| 21 | 0+ | 310 | 41.5 | 2½" | | Bk wing | |
| 22 | >4 | 310 | 42.0 | 1¼" | 2 of 3 " " | Bk, tail | |
| 23 | 0+ | 280 | 41.5 | 2¾" | — | Buff, wing | |
| 26 | 2+ | 315 | 43.0 | 2½" | — | Bk | |
| 27 | >4 | 300 | 43.0 | 1¼" | 2 of 3 | Bk + Buff | |
| 31 | >4 | 305 | 40.5 | 1½" | 2 of 3 | Bk + Buff | |
| 32 | 4+ | 315 | 42.0 | 1¾ | 2 of 3 | Bk + Buff | |
| 33 | ≥5 | 265 | 40.5 | ¾" | 2 of 3 | Bk + Buff | |
| 34 | >4 | 320 | 41.5 | 1⅜" | No white | Buff | |
| 36 | 1+ | 280 | 38.0 | 2¼" | 2 of 3 | Buff + Buff | |
| 37 | >4 | 265 | 41.5 | ¾" | 2 of 3 | Bk + Buff | |
| 38 | >4 | 340 | 42.0 | 1⅛" | No white | Bk | |
| 39 | 1+ | 305 | 40.5 | 2" | No white | Bk, wing | |
| 40 | 1+ | 295 | 42.0 | 2" | No white | Bk | |
| 41 | 2+ | 320 | 42.5 | 1¾" | White on 2 of 3 | Bk | |
| 42 | >4 | 335 | 43.0 | — | 2 of 3 | Bk + Buff | |
| 43 | >4 | 305 | 44.0 | 1¼" | 2 of 3 | Bk + Buff | |
| 44 | >4 | 305 | 43.0 | 1" | 2 of 3 | Bk + Buff | |
| 45 | >4 | 315 | 43.0 | 1¼" | 2 of 3 | Bk | |
| 46 | 1+ | 305 | 40.5 | 2¾" | Some on 2 of 3 | Bk, wing | |
| 48 | 1+ | 290 | 40.5 | 2" | 2 of 3 | Bk | |
| 49 | >4 | 300 | 42.0 | 1" | 2 of 3 | Bk + Buff | |
| 50 | >4 | 285 | 41.5 | 1¼" | 2 of 3 | Bk | |
| 51 | 2+ | 315 | 40.5 | 2" | 2 of 3 | Bk, wing | |
| 52 | 1+ | 305 | 38.0 | 2⅜" | No white | Bk | |

♀♀

| # | Age | L | Wt | | | |
|---|---|---|---|---|---|---|
| 6 | 4+ | 40.5 | 290 | 1½" | small amt white on tail | Bk |
| 10 | 2+ | 39.5 | 290 | ? | 1 white | Bk |
| 12 | 2+ | 39.5 | 310 | 1½" | No white | Bk |
| 17 | 2+ | 41.5 | 295 | 2" | No white | Bk wing |
| 20 | 0+ | 39.5 | 270 | 2" | — | Bk, chest — wing |
| * 24 | 2+ | 405 | 335 | 1¾ | 2 of 3 white | |
| 25 | 2+ | 42.0 | 315 | 2⅜" | No white | Bk |
| 28 | ≥2+ | 39.5 | 300 | 2½" | 1 of 3 white | Bk wing |
| 29 | 1+ | 39.5 | 240 | 2¾" | No white | — |
| 30 | 4+ | 41.5 | 300 | 1⅜" | 2 of 3 | Bk, wing |
| 35 | 3+ | 38.0 | 260 | 2" | 2 of 3 | Bk wing |
| 47 | 1+ | 41.0 | 305 | 2¼" | 1 of 3 | Bk |
| 56 | 2+ | 40.5 | 290 | 1¾" | No white | Bk |
| 57 | 2+ | 40.5 | 300 | 2" | 2 of 3 | Bk, wing |
| 61 | ≥3+ | 41.0 | 315 | 2" | No white | Bk, wing |
| 68 | 2+ | 38.5 | 265 | 1⅞" | 1 of 3 | Bk, wing |
| 70 | 2+ | 41.5 | 320 | 2⅜" | 1 of 3 | Bk, wing |

1998 only liver

76% males collected

| | | | | | | |
|---|---|---|---|---|---|---|
| 110 | 2+ | 37.5 | 260 | 1½" | Little white | 41.0 starting !! |
| 114 | 1+ | | 290 | — | | |
| 115 | 2+ | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 53 | >4 | 360 | 1¼" | 2of3 | Bk, Back |
| 54 | 1+ | 305 | 3" | Nowlite | Bk |
| 55 | >4 | 340 | 1" | 2of3 | Bk, Back |
| 58 | 6+ | 355 | 1½" | 2of3 | Bk, Back |
| 59 | >5 | 310 | Band ? | 2of3 | Bk, Back |
| 60 | 1+ | 252 | 2⅝" | 1of3 | Bk |
| 62 | 2+ | 300 | 1½" | 2of3 | Bk, Back, wing |
| 63 | >5 | 295 | 1¼" | 2of3 | Bk & Back |
| 64 | 2+ | 295 | 2" | 2of3 | Bk + Back |
| 65 | 2+ | 300 | 1⅝" | 2of3 | Wing |
| 66 | 1+ | 295 | 2¼" | Nowlite | Beak |
| 67 | 2+ | 285 | 1½" | 2of3 | Bk, wing |
| 69 | >4 | 270 | 1¼" | 2of3 | Bk + Back |
| 71 | >4 | 305 | 1¾" | 2of3 | Bk, Back |
| 72 | 2+ | 305 | 2½" | Nowlite | Bk, wing |
| 73 | 3+ | 310 | 1½" | 2of3 | Bk + Back |
| 111 | 0+ | 295 | 2" | | |
| 112 | 1+ | 305 | 1½" | | |
| 113 | >4 | 330 | 1¼" | | |
| 116 | 1+ | 265 | - | | |
| 117 | 0+ | 295 | - | | |
| 118 | ≥5 | 335 | 1¼" | 2of3 | |

Approx 75% smalls as collected

DDT

Mallards
> 2240

aldrin

Mallards
Ave 520
(229 - 1210)

dieldrin

381
(141 - 1030)

mule deer
75-150
estimate

endrin

5.6 mallards

goats
25-50

Chlordane

mallards
1200 (954 - 1510)

lindane (γ BHC)

> 2000

Heptachlor

mallards
≥ 2000

methoxychlor

> 2000

Toxaphene

70.7
(37.6 - 133)

mule deer
129 - 240

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Accothion ≡ fenitrothion

LD50 mule deer >727 mg/kg

mallards (392 - 3610) 95% limits
1190 ave.

malathion

mallards (1020 - 2150)
1485 ave.

| No | Species | Sample 1 | Sample 2 | Locality | No | Species | Sample 1 | Sample 2 | Locality |
|---|---|---|---|---|---|---|---|---|---|
| 1 | G.d. | MUSCLE | LIVER | BUSHLAND - PASTURE | 41 | G.d. | " | " | PASTURE |
| 2 | G.d. | " | " | " | 42 | G.d. | " | FAT. | PASTURE |
| 3 | G.d. | " | " | BUSH - PAST. | 43 | G.d. | " | IRRIG PAST. | BUSH - PAST. |
| 4 | CROW | " | " | BUSH - PAST. | 44 | G.d. | " | IRRIG PAST. | BUSH - PAST. |
| 5 | G.d. | " | " | BUSH - PAST. | 45 | G.d. | " | BUSH-PAST. | BUSH - PAST. |
| 6 | G.d. | " | " | BUSH - PAST. | 46 | G.d. | " | TOWN | PASTURE |
| 7 | CROW | " | " | BUSH - PAST. | 47 | G.d. | " | S.F. | PASTURE |
| 8 | G.d. | " | " | BUSH - PAST. | 48 | G.d. | " | PAST. | PASTURE |
| 9 | CROW | " | " | PASTURE | 49 | G.d. | " | PAST. | PASTURE |
| 10 | G.d. | " | FAT. | PASTURE | 50 | G.d. | " | PAST. | PASTURE |
| 11 | G.d. | " | IRRIG PAST. | BUSH - PAST. | 51 | G.d. | " | PAST. | BUSH - PAST. |
| 12 | G.d. | " | BUSH-PAST. | BUSH - PAST. | 52 | G.d. | " | PAST. | PASTURE |
| 13 | G.d. | " | PAST. | PASTURE | 53 | G.d. | " | PAST. | PASTURE |
| 14 | G.d. | " | TOWN | PASTURE | 54 | G.d. | " | PAST. | PASTURE |
| 15 | G.d. | " | S.F. | PASTURE | 55 | G.d. | " | PAST. | PASTURE |
| 16 | G.d. | " | PAST. | PASTURE | 56 | G.d. | " | S.F. | PASTURE |
| 17 | G.d. | " | PAST. | PASTURE | 57 | G.d. | " | PAST. | BUSH - PAST. |
| 18 | G.d. | " | PAST. | BUSH - PAST. | 58 | G.d. | " | PAST. | PASTURE |
| 19 | G.d. | " | PAST. | BUSH - PAST. | 59 | G.d. | " | S.F. | PASTURE |
| 20 | G.d. | " | PAST. | PASTURE | 60 | G.d. | " | PAST. | PASTURE |
| 21 | G.d. | " | PAST. | PASTURE | 61 | G.d. | " | PAST. | PASTURE |
| 22 | G.d. | " | PAST. | PASTURE | 62 | G.d. | " | PAST. | PASTURE |
| 23 | G.d. | " | PAST. | PASTURE | 63 | G.d. | " | PAST. | PASTURE |
| 24 | G.d. | " | PAST. | PASTURE | 64 | G.d. | " | PAST. | PASTURE |
| 25 | G.d. | " | S.F. | PASTURE | 65 | G.d. | " | PAST. | PASTURE |
| 26 | G.d. | " | S.F. | PASTURE | 66 | G.d. | " | PAST. | PASTURE |
| 27 | G.d. | " | " | PASTURE | 67 | G.d. | " | " | PASTURE |
| 28 | G.d. | " | " | PASTURE | 68 | G.d. | " | " | PASTURE |
| 29 | G.d. | " | " | PASTURE | 69 | G.d. | " | " | PASTURE |
| 30 | G.d. | " | " | PASTURE | 70 | G.d. | " | " | PASTURE |
| 31 | G.d. | " | " | PASTURE | 71 | G.d. | " | " | PASTURE |
| 32 | G.d. | " | " | PASTURE | 72 | G.d. | " | " | PASTURE |
| 33 | G.d. | " | " | PASTURE | 73 | G.d. | " | " | PASTURE |
| 34 | G.d. | " | " | PASTURE | | | | | |
| 35 | G.d. | " | " | PASTURE | | | | | |
| 36 | G.d. | " | " | PASTURE | | | | | |
| 37 | RATTLED. | | | | | | | | |
| 38 | BIRDS | | | | | | | | |
| 39 | SAMPLES | | | | | | | | |

SENT 18.10.71

SENT 5.8.71.

SENT 18.10.71

73

| | | |

Bob Prince

# PESTICIDES AND OTHER CONTAMINANTS OF FISH AND WILDLIFE.

## NOTES FOR DISCUSSION.

J.A.K. Lane.
Fauna Research Branch.
May 1972.

In January 1971, officers of the Fauna Research Branch of this department began to collect specimens of the Western Magpie (Gymnorhina dorsalis) to be analysed for pesticide residue content. All specimens were collected at different localities within the South-West Land Division.

To date, 44 of the specimens collected have been analysed for residues of organochlorine pesticides.

For each specimen, both liver and muscle tissue have been analysed.

Results are as follows.

1) DDT (as DDT or DDE) and dieldrin residues have been found in all tissues analysed.

2) Liver tissue concentrations are generally higher than those of muscle and range from less than 0.001 ppm to 6.32 ppm DDT, and from less than 0.001 ppm to 3.1 ppm dieldrin.

3) High DDT levels are associated with high dieldrin levels (the highest levels of DDT and dieldrin were found in the same animal.)

4) Levels found in particular specimens reflect the intensity of use of these pesticides at the site of collection. eg. Highest levels were found in the intensive crop production areas of Donnybrook, Bridgetown, Manjimup and Pemberton. DDT and dieldrin are used extensively in these areas for pest control.

The results of our studies so far raise many unanswered questions.

Firstly, what is the biological significance of the levels of DDT and dieldrin contamination which have been found in magpies? To answer this question it will be necessary to conduct trial-feeding experiments using captive animals, and to study and compare the dynamics of contaminated and uncontaminated populations of magpies.

Secondly, the boundaries of areas of high contamination are ill-defined due to the small number of birds sampled. More intensive sampling is required to establish these boundaries.

Thirdly, in these areas of high contamination, are other species of wildlife accumulating biologically significant amounts of these pesticides? The most obvious are the raptores which, because of their position in the food-chain, are most vulnerable to "biological magnification" of pesticide residues.

Fourthly, we know nothing of the level of contamination of our lakes, rivers, estuaries and oceans.

Fifthly, we know little, if anything, of other environmental contaminants which may be affecting our fish and wildlife. Possible candidates are mercury and arsenic and their compounds, and the well publicized polychlorinated biphenyls.

Obviously, to answer these questions, it will be necessary to considerably expand the present line of investigation.

A proposal for expansion is outlined below.

1) Collation of data on all pertinent aspects of the production, use and disposal of chemicals which overseas or interstate investigations have shown to be serious contaminants of wildlife.

The following chemicals fall into this category:-

a) organochlorine pesticides
b) mercury and mercurial compounds
c) arsenic and arsenical compounds
d) polychlorinated biphenyls

2) Monitoring of yearly fluctuations or trends in the level of contamination by these compounds and localization of areas of high contamination by the establishment of suitable monitor species.

3) Identification of species which are accumulating dangerously high levels of these contaminants.

4) Determination of the biological significance of the levels of contamination in monitor species and in identified species (3) by appropriate field and laboratory studies.

## 1. Collation of Usage Data for Environmental Contaminants.

Data on usage are necessary

i) to indicate whether or not a particular compound is used or lost to the environment in such a manner or amount that it might constitute a serious hazard to wildlife.

ii) to indicate where contamination is likely to occur, and which of these areas is likely to be most seriously contaminated.

iii) to decide which species of wildlife are most likely to be affected. Useage data is especially important here since the method of application or loss to the environment will determine which species are most vulnerable. For example, in this state one of the major uses of mercury is for seed dressing (see below). Wildlife most vulnerable to contamination are therefore the seed-eating birds.

iv) to accurately identify the source of contamination so that means of reducing the level of contamination can be considered in an informed manner.

The present situation in regard to our knowledge of usage of environmental contaminants is summarised as follows.

a) Organochlorines:

Usage data for organochlorines is at present being sought from pesticide manufacturers and formulators operating in this state. A few companies (eg. Amalgamated Chemicals) are prepared to give annual sales figures for individual compounds and some indication of their area of use. Most other companies (eg. Shell Chemical Co. - sole manufacturers of dieldrin in W.A.) although not prepared at this stage to divulge their sales figures are prepared to give rough indications of where and how their products are used. We are investigating the types of guarantees of confidentiality which we can give to these companies in an endeavour to extract more detailed information from them.

The Agriculture Protection Board is cooperating by providing information on the history and present status of the Argentine Ant Control programme, a major dieldrin consumer.

It appears that the heaviest use of pesticides in this state is in the Ord River Region. A formidable list of pesticides has already been compiled for this area.

b) Mercury:

The two main consumers of mercury in this state are agriculture and industry.

i) Agriculture

More than 200,000 lbs of seed dressing containing approximately 1.5% mercury is used to dress wheat, barley and oat seed before seeding. This is by far the biggest use of mercury in agriculture.

Since all five seed dressing companies in this state are prepared to supply figures on their annual use of dressing compounds, accurate data is available for whole of state consumption.

It should be noted that mercurial seed dressings were the major cause of contamination of terrestrial ecosystems in Sweden.

ii) Industry

In the U.S.A., Canada and Sweden the principal sources of mercury pollution of the aquatic environment have been discharges from chlor-alkali plants and paper and pulp mills. In this state there is only one chlor-alkali plant (Kwinana Chemical Company) and this uses diaphragm cells, not mercury electrodes. There are no pulp mills, and the only paper mill in the state (Australian Paper Manufacturers) does not use mercurial slimicides. These two industries therefore do not discharge mercurial wastes.

The biggest industrial consumer of mercury in this state is the gold industry, metallic mercury being used in the gold amalgamation process. State Batteries alone have accounted for more than 34,000 lbs of the 1,430,000 lbs of mercury which has been imported into the state since 1891. Yearly import figures for metallic mercury (provided by Bureau of Census and Statistics) reflect gold production, peak consumption being 1905 - the "gold rush" era.

840,000 ?

The mercury used in gold amalgamation is lost to the environment as vapour by a distillation process, and as inorganic compounds of mercury in tailings.

Other uses of mercury are in the electrical and paint industries, pharmaceuticals, industrial and control instruments, dental preparations and general laboratory uses.

Little information is to hand on these uses however it is thought that they do not involve more than 500 lbs per year.

Burning of fossil fuel releases mercury to the environment. Arrangements are being made to analyse coal, fuel oil and ash for mercury content so that combined with figures for mercury consumption, an estimate may be made of mercury losses to the environment. Since power generation involves the combustion of large amounts of fossil fuel (approx. 1.2 million tons of coal/year in W.A.), even low concentrations of mercury can produce significant discharges (eg. 0.5 ppm Hg in coal gives 0.6 tons Hg per year, which is worthy of consideration when compared with present annual metallic mercury imports - 2,000 lbs/year).

c) Arsenic:

In agriculture arsenical compounds (typically $As_2O_5$) are used for weed control, for destruction of leaf-eating insects, in timber preservatives, and as a liquid dip for destruction of sheep lice and itchmite.

Approximately 2 tons of $As_2O_5$ is used for weed control in the Ord River Region each year.

No attempt has yet been made to research industrial and other uses of arsenic.

d) Polychlorinated Biphenyls:

No information has yet been sought on PCB use in West Aust.

2. Monitor Programme.

A monitoring programme is necessary

a) to provide information on the distribution of contaminants in the environment.

b) to monitor trends or fluctuations of contaminant levels in particular geographic areas from year to year.

c) to identify and delimit areas of high contaminations so that these areas may be more intensively studied.

d) to determine the success or otherwise of steps taken to reduce levels of contamination.

The following vertebrate species are considered to be suitable for monitoring contamination in the southern half of Western Australia.

a) Western Magpie (Gymnorhina dorsalis) - terrestrial contamination.

This species is:

i) widespread throughout most of the southern half of the state,

ii) plentiful (total population is estimated to be between 450,000 and 900,000 birds),

iii) territorial (territory size of 25 - 200 acres),

iv) long-lived (up to 9 years in the field),

v) top of a food chain,

vi) ageing is possible; and

vii) not difficult to keep in captivity for feeding trials.

Sampling would include

i) first-moult birds (for information on relative contamination of different areas and to follow changes in birds for particular localities from year to year), and

ii) sexually mature birds (for information on accumulation of contaminants).

b) Estuary Cobbler (Cnidoglanis macrocephalis) - river and estuary contamination.

This species

i) is found around the southern half of the continent as far north as Sharks Bay

ii) is plentiful

iii) is sedentary (individuals are restricted to particular estuaries)

iv) has a life-span of 3 - 4 years

v) is high in a food chain

vi) is not difficult to age (a strong correlation exists between total body length and age - at least for the Swan River)

vii) is not difficult to keep in captivity.

c) Pied Cormorant (Phalacrocorax varius) and
Crested Tern (Sterna bergii)

These are the two sea-bird species most suitable for monitoring contamination of coastal waters, however I feel that some species of fish may be more suitable.

At the present stage of development a monitor system for the northern half of the state is not warranted. Monitoring should here be restricted to the few localities where high contamination is likely. (i.e. Ord River Region and Carballin).

3. Endangered Species.

Within areas of high contamination, as identified and delimited by usage data and results from the monitor programme, it will be necessary to study wildlife species most vulnerable to contamination. In the case of DDT and dieldrin these are the raptors and the fish-eating birds. Other groups of animals more directly exposed to contaminants will also require study (eg. ducks and other birds feeding on dressed seed).

Initially these studies would simply involve the collection and analysis of small samples. Further studies would only be necessary if high (as judged by overseas results) levels of contamination were found.

High levels of contamination are thought to exist in the Ord River Region. Samples of fish and wildlife will therefore be collected from this region in late June to be analysed for pesticide content.

4. Biological Significance.

It would be desirable to determine the biological significance of levels of contamination found in monitor and endangered (as above) species by appropriate field and laboratory studies. However studies of this nature cannot be undertaken with the research facilities presently available, nor are they necessary at this early stage of investigation.

# Paws sapled

Live DD Nests 0.61 Dld 0.04

| | | | | | | |
|---|---|---|---|---|---|---|
| SFor | 1 | Ile Isle Rd | Pickering Brook | | 1st year ♂ 8-9 mos | |
| | 2 | | Older bird greater | but ?? Age of Sex confd | 2nd year ♀ | 1.93 Lio 0.03 |
| SFor | 25 | Monath Cave Area | ♀ 3rd Moult | | 0.05 | 0.02 |
| | 26 | | ♂ 3rd Moult | (by Sex) ie = | 0.08 | 0.02 |
| Pasture | 29 | | ♀ 2nd Moult | | 0.03 | 0.01 |
| | 30 | | ♀ 4yrs | age + | 0.10 | 0.01 |
| Pasture -Beach Rd | 34 | | ♂4+ | =ott | 0.13 | 0.14 |
| | 35 | | ♀ 3yrs | sex age confd | 0.06 | 0.14 |
| Pasture -Beach Rd | 38 | | ♂ 4+ | = or — age | 0.06 | 0.02 |
| | 39 | | ♂ 2nd Moult | | 0.05 | 0.2 |
| P -B | 44 | | ♂4+ | "Ave adj" Sex Age & Matched | 0.4 | 0.05 |
| | 45 | | ♂4+ | | 0.2 | 0.02 |
| Pasture | 47 | | ♀ 2nd Moult | = Sex | 0.04 | <0.005 |
| | 48 | | ♂ 2nd Moult | | 0.04 | <0.005 |
| P- | 63 | | ♂5+ | Age + | 0.007 | <0.002 |
| X | 64 | | ♂ 3rd Moult | | 0.004 | <0.002 |
| Pasture | 69 | | ♂4+ | Age sex confd | 0.01 | 0.009 |
| | 70 | | ♀ 3rd Moult | | 0.03 | 0.02 |
| Pasture | 71 | | ♂4+ | Age = | 0.06 | 0.02 |
| | 72 | | ♂ 3rd Moult | | 0.06 | 0.03 |

Pairs

| | | Liver DDT+ | Liver Dldrn |
|---|---|---|---|
| 111 [=130] | Kanangulla-Pechey Brook Rd 1 mi N of KARRAKATTA ♂ 1st moult | 3.6 | 1.8 |
| 112 [=135] | as above ♂ 2nd moult | 6.8 | 1.1 |
| 115 [=124] | Hackett Gully (Vicks place) ♀ 3rd Moult | 25.0 | 0.08 |
| 116 [=131] | as above ♂ 2nd moult | 1.7 | 0.1 |
| 141 | Nearby Ck, VIVEASH ♂ Adult - 4th M | 1.7 | 0.7 |
| 143 | do ?♂ 2nd Moult | 1.7 | 0.2 |

Total 6

Dec 1970 JAKL etc

A = Guilderton

| L | M |
|---|---|
| 0.017 | 0.014 |
| 0.43 | 0.11 |

B. Watheroo

| L | M |
|---|---|
| Na. | 0.027 |
| | 0.022 |

C. Marchagee

| L | M |
|---|---|
| 0.023 | 0.010 |
| 0.007 | 0.005 |

Mingenew Aug 71

| | L | M |
|---|---|---|
| # 75 δ 3rd | 0.01+ | a. |
| | 0.01 | a |
| # 76 δ 3rd | 0.03 | 0.01+. |
| | 0.01 | a |
| # 80 δ 2nd | 0.02+ | a |
| | 0.02 | a |

"HCB" also detected at recorded levels 0.01

8 total

JAKL etc

Lead Harvey Area

Coll. Dec 1970

| | | | L | M | |
|---|---|---|---|---|---|
| α | 1) | SE corner of Harvey estuary | 0.179 | 0.052 | DDT+ |
| | | | 0.009 | 0.001 | Dieldrin |
| β | 2) | Robert Bay Lead Inlet | L | M | |
| | | | 0.011 | 0.007 | |
| | | | 0.003 | 0.002 | |
| γ | 3) * | Greenland Road, Punjam | L | M | |
| | | | 0.011 | 0.006 | |
| | | | 0.006 | 0.002 | |

February 1971

8403-4 Sme. c/w Mt Dudley

| | | | L | M |
|---|---|---|---|---|
| X | | | 0.07 | 0.02 |
| | | | 0.01 | 0.01 |

8405-6 4 mi SSE ? S Dudley T/O, westside of Harvey estuary

| | | | L | M |
|---|---|---|---|---|
| Y | | Locality??? | 0.04 | 0.01+ |
| | | | 0.04 | 0.02 |

Stored to 1974 Coll. February 1971

| | | | L | M |
|---|---|---|---|---|
| 119 | | 6.7 mi to Heron Point | 0.02 | 0.04 |
| 120 | * | 10 mi along Greenland Rd | 0.008 | 0.004 |
| 121 | | | 0.01 | 0.002 |

Coll loc similar to 119–120

## Areas

♀ 3rd ♂ Adult(4+)

110 ♀3rd ✓
147 ♂ Adult ✓

Wymbolt Serpentine
(P) (P) (P) (P) (P)
67, 68, 69, 70, 73
♂ 3rd ♀ 3rd ♂ 4+ ♀ 3rd ♂ 4+

(67) 0.1 0.4 (68) 1.2 0.5
(69) 0.01 0.009 (70) 0.08 0.02
(73) 0.07 0.01

age unrelated 2 ♀♀, 3 ♂♂ all on pasture land

Keysbrook ⇔ Dwellingup → Harvey
(P) (P) (P) (P) (P/P) (P) (P) (P)
71, 72, 3, 65, 66, 5, 6, 8
♂ ♂ ♂ ♂ ♂ ♂ ♀ ♂
4+ 3rd 4+ 3rd 2nd 4+ 4+ 4+5

4+ + 4

(3) 0.08 0.02
(5) 0.32 0.02
(8) 0.02 0.01
(71) 0.06 0.02 ↔ (6) 0.04 0.01

4 ♂♂ = 4+, 1 ♀ = 4 all pasture
+ 2 ♂♂ = 3rd + 1 ♂ = 2nd (P)

♂♂ 3rd ♀♀
(72) 0.06 0.03
(45) 0.01 0.004
(66) 0.06 0.04

Waterloo – Dardanup – Capel
(Inv) (Inv) (P/B)
10, 11, 12
♀ 3rd ♂ 4+ ♀ 3rd

(11) ♂ 0.07 0.03
♀♀ (12) 0.06 0.02
(13) 0.05 0.02

Not
Boyanup – Capel – Newton
(P) (P) (P) (P)
16, 17, 18, 19
♂ ♀ ♀ ♀
≥5 3rd 3rd 3rd

(17) 1.80 0.60
(18) 0.49 0.10
(19) 0.01+ 0.01

2 ♂♂ = 3rd, 1 ♀ = 3rd
+ 1 ♂ ≥ 5 0.41 0.22 (16)

(P) Orchards
7, 15
♂ ♂ 4+
0.01 0.01

Brunswick – Margaret River
(P) (P) (P) (SF) (P/P) (SF) (SF) (P)
20, 21, 22, 23, 24, 25, 26, 27
♀ ♂ ♂ ♂ ♀ ♀ ♀ ♂
✓1st ✓1st ✓4+ ✓1st 3rd 3rd 3rd 4+

SF ♂ 1st
(23) 0.03 0.10
(21) 0.16 0.80
(20) 0.3 0.03
139 ♂M 0.02 0.007

P ♂ 4+
(22) 0.28 0.08
(27) 0.04 0.03

SF ♂ 3rd
(26) 0.02 0.02
♀
(25) 0.05 0.02
♂ P
(24) 0.02 0.02

Nannup – Mullalyup – Bagship Rd
Manjimup – Pemberton
(P/F) (P) (P/B) (P/F) (P) (P) (P/B) (P/B) (P/F) (P/F)
28, 29, 30, 31, 32, 33, 34, 35, 36, 37
♀ ♀ ♀ ♂ ♂ ♂ ♂ ♀ ♂ ♂
3rd–4+ 2nd 4 4+ 4 ≥5 4+ 3 2nd 4+

P/F, B ♂ 4–4+
(31) 0.13 0.04
(34) 0.13 0.14
(29) 0.7 1.0

P/F/B ♀
(28) 6.82 3.1

♂ 4+ P
(33) 0.02 0.14
(32) 0.54 0.16

♀
(35) 0.06 0.04
(30) 0.10 0.01

♂ 4+ P 3rd
(29) 0.03 0.01

1/F/B 2nd
(36) 1.25 0.05

Collie (Mumballup) Darkan
(P) (TN) (SF) (P) (P) (P) (P) (P)
13, 14, 55, 56, 54, 57, 58
♂ ♂ ♂ ♀ ♂ ♀ ♀ ♂
4+ 4+ 4+ 2nd 2nd 3rd ✗

(14) ♂ 0.09 0.02
♀ (55) 0.02 <0.0
(56) 0.02 0.02
TN (13) 0.02 0.02
(58) 0.01 0.01

♂♂ 4+ no title
(54) 0.10 0.02
♂ ≥ 5 (38) 0.02 <0.0
♂ 3rd
(54) 0.10 0.02

Quelup – Forrest – Rocky Gully
(P) (P) (P/B) (P) (P) (P) (P) (P)
53, 52, 51, 50, 49, 47, 48, 46
♂ ♂ ♂ ♂ ♂ ♀ ♂ ♂
4+ 2nd 3rd 4+ 4+ 2nd 2nd 2nd

♂♂ 4+ P
(53) 0.05 <0.0
(50) 0.04 <0.0
(49) 0.2 <0.0

♂♂ 2nd P
(52) 0.1 <0.0
(42) 0.04 <0.0
(46) 0.06 0.02

♀ 2nd P
(47) 0.04 <0.0

♂ 3rd P/B
(51) 0.02 <0.0

Kedaup Mt Barker Albany
(P/B) (P/B) (P/B) (P) Dandaragan (P) (P/B) (B/P) (A/P)
44, 45, 40, 41, 42, 43, 38, 39
♂ ♂ ♂ ♂ ♂ ♂ ♂ ♀
4+ 4+ 2nd 2nd 4+ 4+ 4+ 2nd

♂♂ 4+ P
(52) 0.2 0.1
♂♂ 4+ P/B
(44) 0.4 0.05
(45) 0.2 0.02
(43) 0.3 0.1
(38) 0.06 0.02 P/B ↔ ♂ 2nd (39) 0.05 0.2 P/B

♂ 2nd P
(41) 0.08 0.01
♂ 2nd P/B
(40) 0.1 0.04

## Williams – Baldivis

(P) (P) (P/B) (A/B) (P)
59, 60, 61, 62, 63, 64
♂ ♂ ♀ ♂ ♂ ♂
5+ 2nd 3 or 4 3rd 5+ 3rd

♂♂ 5+ P
(59) 0.01 0.01
P/B
(62) 0.007 <0.00

♂ 3rd M P
(64) 0.004 <0.00
P/B
(63) 0.007 <0.00

♂ 3rd P
(60) 0.01 <0.00

♀ 3 or 4 yrs (P)
(61) 0.00) <0.00

## Lychering Brook

(SF) (SF)
1, 2
♂ ♀
1 at yr 2nd year
0.61 0.04

1.73 0.03

others were sampled later.

orchard area

111, 112, 113, 114, 115
♂ 1st ♂ 2nd ♂ 4+ ♀ 2nd ♀ 3rd
116, 117, 118
♂ 2nd ♂ 1st ♂ (5-6)

♂♂ 1st ♂♂ 2nd ♂♂ 4+
(111) 3.6 1.8 (112) 6.8 1.1 (113) 9.8 0.4
(117) 0.5 0.1 (116) 1.7 0.1 (118) 8.2 0.05

♀ 2nd
(114) 0.2 0.06
♀ 3rd
(115) 25.0 0.08

21 vs 22 comparison inconclusive

✓ 144 Nth Beach
♂ Adult
3.8 2.2

✓ 140 WILLETTONS ?
3rd Moult
33.0 12.0
[Donelly Claremont 12.0 19.0]*

Adult ♂
Gr Butcher Bird
3.2 3.2

* 126 Eric St, Como
✓ ♂ Adult
3.2 1.0

✓ 134 Sandra St Como
? 1st Moult
Iliac NA + Muscle
4.2 3.2

143 ✓ Stewartly Cres Victoria
♂ 2nd M
1.7 0.2

✓ * Donnelly Claremont
12.0 19
died after garden spraying

141 ✓ Ian 143
♂ 4th M Adult
1.7 0.7

128 ✓ CLOVERDALE
♂ 2nd Moult
1.7 1.7

* 129 ✓ MORLEY
♂ Adult
1.2 . 1.5

✓ 145 MORLEY
♂ Adult ✓
0.6 0.2

122 ✓ SCARBOROUGH
0.02 0.01

✓ 146 BALCATTA ✓
0.5 0.3

---

Loc^n not specified

✓ 142 ♂ Adult ? 0.5 0.5

✓ 125 ♀ 3rd M 3.4 3.4

✓ * 123 ♂ 4+ 2.0 1.7 *

✓ 142 ♂ Adult 0.5 0.5

152 Henry Hall 14/2/72 ✓
NA ♂ Adult (74) 305g
[348]

153 Henry Hall [308]
NA ♂ 3rd Moult 14/2/72
(74) 270g

cf magpie #140
#138 Kent St, WILLETON 13/10/72
Grey Butcher Bird (74) 89g
♂ Adult

| | L | M |
|---|---|---|
| DDT | 3.2 | 1.8 |
| Dld | 3.2 | 1.6 |

#139 = No 1 of ?? Not dated Coll
Plus not located on label [366] ✗
♂ G.d. adult (74) 320g

Prob. CAPE

WOK Museum (=Fay) 11/10/72 Shot Mt Cooper by Keith Hall G.d.
18/7/71

3 Magpies Mirrenew Aug 71

Outside Metro etc
G. dorsalis ex Gas
* [336]
119 67 miles from Hann Port on Bitumen Rd 11/7/71 ✗
? JAKL ? ♂ 3rd M (74) 294g

| | L | M |
|---|---|---|
| DDT+ | 0.02 | 0.04 |
| Dld+ | 0.02 | 0.002 |

Do 10 mls along Greenland Rd * 8/7/71 [286] ✗
? JAKL ? new 1st or 2nd M (74) 250g

| | L | M |
|---|---|---|
| *see below | 0.008 | 0.004 DDT+ |
| | 0.01 | 0.002 grossly contg |

?? Loc MH Area * 9/7/71 [369]
121 ♂ Adult (74) 323g ✗

| | L | M |
|---|---|---|
| | 0.006 | 0.004 |
| | 0.01 | 0.002 grossly contg |

#110 (136) Lake Cave Do Sth Hwy 7/72 262
DDT 0.04 0.05 ♀ 3rd M (74) 230g
Dld 0.008 0.004 [0.878]

#147 Mead St BXFORD - 12/10/72 [306]
(= " ) (74) 268g

| | L | M |
|---|---|---|
| DDT+ | 0.2 | 0.08 |
| Dld | 0.05 | 0.02 |

♂ Adult

REPORT COPIES

* Ref also Magpie JAKL folio 21 18/7/71 + 6 others 19.10 folios A1+A2

Metro Area

WOI — Destruction of Dangerous Animals

C. Manuelli

failed 0.875

. 128

| | L | M |
|---|---|---|
| ✓ | 1.7 | 0.4 |
| | 1.7 | 0.4 |

Trunk St, Cloverville (= Osborn)

♂ Adult Male

[287] ✗ 25/11/72 (74) 251g

. 129

| | L | M |
|---|---|---|
| ✓ | 1.2 | 0.4 |
| | 1.5 | 0.2 |

Bell Rd, Alexcel (= ??)

♂ Adult

[331] ✗ 2/10/72 (74) 290g

. 134

| | L | M |
|---|---|---|
| ♀ | | 4.2 |
| ♂ | NA | 3.2 |

Sandown St, Comic (= Osborn)

♂ Adult Male

[383] ✗ 30/10/72 (74) 335g

. 140

| | L | M |
|---|---|---|
| ✓ | 33.0 | 2.3 |
| | 12.0 | 1.1 |

[illegible] (= ??)

♂ Adult Male

[250] ✗ 13/10/72 (74) 319g

. 141

| | L | M |
|---|---|---|
| ✓ | 1.7 | 0.4 |
| | 0.7 | 0.1 |

≠ 143

[illegible] (= ??)

♂ Adult - Other

[359] ✗ 11/10/72

. 122

| | L | M |
|---|---|---|
| ✓ | 0.02 | 0.02 |
| | 0.01 | 0.002 |

Hartog St Scunthorpe (= Noble)

♂ Adult Male

[335] ✗ 2/11/73 (74) 325g

. 122

| | L | M |
|---|---|---|
| ✓ | 2.0 | 0.4 |
| | 1.7 | 0.3 |

? Loc not spec (= Osborn).

♂ Adult Male (white bait)

[362] ✗ 30/9/72 (74) 317g

. 125

| | L | M |
|---|---|---|
| ✓ | 3.4 | 0.4 |
| | 3.4 | 0.5 |

? Loc not spec (= ??)

♀ Adult

[359] 17/11/72 (74) 314g ✗

. 126

| | L | M |
|---|---|---|
| ✓ | 3.2 | 0.9 |
| | 1.0 | 0.2 |

Eric St Comic (= ??)

♂ Adult

[354] ✓ 3/10/72 (74) 310g

| | L | M |
|---|---|---|
| | 12.0 | 9.6 |
| | 19.0 | 13.0 |

O'Donnelly, RP 1471 CLAREMONT

147

| | L | M |
|---|---|---|
| DoT | 0·2 | 0·08 |
| Dld | 0·05 | 0·02 |

Repeat listing

148

NA

149

NA

150 cf 146

NA

151

NA

Mead of Approx
( = ?? )
♂ adult

142
- [306] ✗
31/10/72
(74) 268g

| L | M |
|---|---|
| 0·5 | 0·3 |
| 0·5 | 0·2 |

?? location
( = ?? )
♂ adult

13/10/72 - [345] ✗
(74) 302g

143
- [350]
6/10/72
(74) 310g

| L | M |
|---|---|
| 1·7 | 0·3 |
| 0·2 | 0·03 |

cf 141

Stanwix Cr. VIVIPARA (MICROCENTRUS)
( = ?? )
♂ adult

13/10/72 - [344] ✗
(74) 201g

Cinclus Mill, Caerleg Hyg Allerdean
( = Corbridge )
♀ adult

144
- [350]
17/10/72
(74) 310g

| L | M |
|---|---|
| 3·8 | 1·2 |
| 2·2 | 0·3 |

Tessidii Rd LOCKRIDGE
( = Rennington )
♂ Adult

145
- [349]
16/10/72
(74) 305g

| L | M |
|---|---|
| 0·6 | 0·4 |
| 0·2 | 0·1 |

Rosehill Cottage RAILWAY
( = ?? )
♀ Adult

57 Alnwick Newcastle Road Bridge
( = ?? )
♂ adult

6/10/72 - [338] ✗
(74) 296g

Russell pl + walls Rd Alnwick
( = ?? )
♂ adult

11/10/72 - [379] ✗
(74) 332g

146
- [291]
13/10/72
(74) 255g

| L | M |
|---|---|
| 0·5 | 0·4 |
| 0·3 | 0·1 |

cf 150

Lesbury Cross Street
( = ?? )
♂ adult

6/10/72 - [338] ✗
(74) 276g

115
[124]

Hackett Gully — no Vial ≡ [illegible]

♀ 3.0 M

| L | M |
|---|---|
| 25.0 | 9.0 |
| 0.08 | 0.01 |

[illegible] 2/72] 295 g
(74) = 256 g
[0.868]

116 [illegible] 115
[121]

| L | M |
|---|---|
| 1.7 | 1.2 |
| 0.1 | 0.02 |

E=2/72] 265 g
(74) 235 g
[0.887]

117
[130]

[illegible]

| L | M |
|---|---|
| 0.5 | 0.3 |
| 0.1 | 0.008 |

[illegible] 295 g
[illegible] 258 g
[0.875]

118 [illegible]

| L | M |
|---|---|
| 8.2 | 14.0 |
| 0.05 | 0.1 |

[illegible] 334
[illegible] 293 g
[0.867]

119 [illegible]

Ave [0.876]
last wet measure
= 12.5%

[illegible]

G. dorsalis.

[illegible]

110
[136]

SW Hwy ½mi S to Sept. Dam.

♀ 3.8 mm P

| L | M |
|---|---|
| 0.01 | 0.05 |
| 0.008 | 0.004 |

Repeat Lusting

111 • Karangahake — Rail Bdge [illegible]
[130]

| L | M |
|---|---|
| 3.6 | 0.8 |
| 1.8 | 0.3 |

112 [illegible]
[135] •

| L | M |
|---|---|
| 6.8 | 3.8 |
| 1.1 | 0.6 |

113
[137]

| L | M |
|---|---|
| 9.8 | 3.8 |
| 0.4 | 0.4 |

114
[127]

| L | M |
|---|---|
| 0.2 | 0.2 |
| 0.06 | 0.03 |

[illegible]

Cytos.
Cuticle

[Pelorus Bridge]

Wet Sk [illegible] 262g
Dry [illegible] 74) 22.0g
[0.878]

[illegible] 74) 250g
[0.847]

[illegible] 74) 260g
[0.879]

[illegible] 74) 300g
[0.916]

[illegible] 74) 247 g
[0.851]

8 Birds Pinjarra MH Area
Dec 70 - Feb 71

Mandie Red Kangaroo

3 birds Nth of Kett Dec 70

+ 3 at Ningnew Aug 71

Year M F

1972 3015 227 None

1973 2375 954 3329 266 108 374 2641 (89.9%) 3703*

Xtra 8 birds Orchard area to Hill. Cot Rd

1974 3504 None 590 4094 (85.5)

1975 1280 None 939 2219 (57.7)

1976 1761 707 2468* 124 per cale 2712 (50.4) 1387 (51.0) 4099 (50.6)

Season ?? 1977 2966 None 2811 — 5777 (51.3)
in Feb 72 JJ 71)

1978 2140 None 2089 — 4233 (50.6)

1979 2281 None 2449 12/71 — 4730 (52.4)

1 bird thetis area

1980 754 1831 2585 790 1802 2592 1544 3633 5177 (49.9)

+ 13 Oct Nov 72

15+ (1)

* Cutting KOORATTA area (computed)

1 April 78 ??? omit for report

delete this one from list to discuss in paper

1 Feb 72 Armadale - Pinjarra

1 Oct 72

1 capel

109 for 3 → 10 birds + baths

Mr. R. Prince.

The Director,
Government Chemical Labs.,
64 Adelaide Tce.,
PERTH. W.A. 6000

3/5/72.

Attention Mr. Houghton.

A dead Masked Owl (Tyto novae-hollandiae) has recently been forwarded to this Department. It has been suggested that this bird may have been the victim of secondary poisoning resulting from '1080'.

Circumstances are as follows:-

The owl was found alive on the ground and was easily captured. An experienced naturalist who saw this bird immediately after capture noted that it appeared to be unwell. The bird died the next morning while in his possession and was placed into a deep freeze unit pending contact with the Local Fauna Warden.

The suggestion that '1080' was involved was based on the fact that the bird was found in the vicinity of recently laid poison trails and that two dead birds had been picked up in similar circumstances last year and again this year. In addition, the apparent disappearance of local populations of these birds within the space of two to three weeks after the laying of those poison trails had been noted.

Accordingly tissues of this bird thought likely to contain the highest concentrations of '1080' if present are forwarded herewith for analysis. Tissues are:-

1) Liver
2) Kidneys
3) Gut

If these tissue samples are not wholly used up in the course of the required analyses I would be grateful if the unused portions of fresh tissues could be returned to this Department.

B.K. Bowen.
Director.

DUPLICATE

Department of Mines, Western Australia

**GOVERNMENT CHEMICAL LABORATORIES**

30 Plain St., Perth, Western Australia, 6000. Tel. 25 5544

Correspondents should confine each letter to one subject. Write on one side of the paper only. Address all correspondence to the Director.

Director
Department of Fisheries & Fauna
108 Adelaide Terrace
PERTH
Western Australia 6000

21 July 1972 GWD

Attention: Mr. R. Prince

OUR REF:

YOUR REF:

MATERIAL: Three samples, marked as below, from a masked owl.

LAB No. 6902-6904/72

FROM WHOM RECEIVED AND DATE: Department of Fisheries & Fauna on 3 May 1972.

RESULT OF EXAMINATION:

Gut: (Lab. No. 6902/72)

Marks: "Gut"

Weight of sample: 6 grams

Result of examination:

Sodium monofluoroacetate was not detected in the sample.

(Limit of detection, 0.01 milligrams in the whole exhibit, i.e. approximately 2 parts per million).

Kidney and Liver:

(Lab. Nos. 6903-4/72)

Marks: "Kidney, Liver"

Weight of bulked samples: 7 grams

Result of examination:

Sodium monofluoroacetate was not detected in the sample.

(Limit of detection 0.01 milligrams in the whole exhibit, i.e. approximately 2 parts per million).

The kidney and liver were bulked due to the small weight of each sample.

The gut was examined separately as it was considered more likely to contain any residue of "1080".

No tissue remained after the above analyses.

R.W. HORNE
CHEMIST & RESEARCH OFFICER

N.R. HOUGHTON
CHIEF OF DIVISION
FOOD, DRUGS & TOXICOLOGY

Submitted to Govt Chem labs

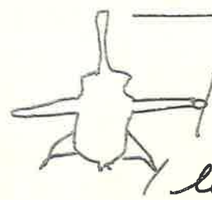
Bird No 1. Juvenile – fresh almost.

Bird No 2 Juvenile – starting to decay.

Bird No 3 Adult – advancing stage of decomposition

Seagulls from Canvey I after Rabbit poisoning

all Birds skinned and heads – wings – and legs removed.



wing severed at "elbow"

legs severed at thigh

Submitted to Mr Houghton further birds

3 freshly dead
3 shot } 16/7/69

contents as above.

The Director,
Government Chemical Labs.,
64 Adelaide Tce.,
PERTH. W.A. 6000

Mr. R. Prince.

3/5/72.

Attention Mr. Houghton.

A dead Masked Owl (Tyto novae-hollandiae) has recently been forwarded to this Department. It has been suggested that this bird may have been the victim of secondary poisoning resulting from '1080'.

Circumstances are as follows:-

The owl was found alive on the ground and was easily captured. An experienced naturalist who saw this bird immediately after capture noted that it appeared to be unwell. The bird died the next morning while in his possession and was placed into a deep freeze unit pending contact with the Local Fauna Warden.

The suggestion that '1080' was involved was based on the fact that the bird was found in the vicinity of recently laid poison trails and that two dead birds had been picked up in similar circumstances last year and again this year. In addition, the apparent disappearance of local populations of these birds within the space of two to three weeks after the laying of those poison trails had been noted.

Accordingly tissues of this bird thought likely to contain the highest concentrations of '1080' if present are forwarded herewith for analysis. Tissues are:-

1) Liver
2) Kidneys
3) Gut

If these tissue samples are not wholly used up in the course of the required analyses I would be grateful if the unused portions of fresh tissues could be returned to this Department.

B.K. Bowen.
Director.

DUPLICATE

6 of

F+W 187/71

# GOVERNMENT OF WESTERN AUSTRALIA

GOVERNMENT CHEMICAL LABORATORIES
TEL. No. 23 1443
30 PLAIN STREET,
PERTH,
W. AUST., 6000.

BC

Correspondents should–
Confine each letter to one subject.
Write on one side of the paper only.
Address all correspondence to The Director.

Director,
Department of Fisheries and Fauna,
108, Adelaide Terrace,
Perth, W.A. 6000.

13th January 1970

OUR REF.

YOUR REF.

Attention: Mr. Arnold

MATERIAL: One sample (Willy Wagtail)

LAB. No. 18886/69.

FROM WHOM RECEIVED AND DATE: Department of Fisheries and Fauna, on 8/12/1969.

RESULT OF EXAMINATION:

| | parts per million |
|---|---|
| Lindane | 0.02 |
| Aldrin | 0.01 |
| Heptachlor epoxide | 1.0 |
| D.D.E. | 0.85 |
| Dieldrin | 0.05 |
| D.D.T. | 0.05 |

The whole bird, which weighed 18 gram, was comminuted prior to analysis.

No other organochlorine pesticides were detected.

W.R. Wood.

W.R. WOOD,
ASSISTANT CHIEF OF DIVISION,
FOOD, DRUGS AND TOXICOLOGY.

Ref indicator species
Criteria for selection
= Moore, N.W. (1966)
pp 262-3

Supp to J. appl. Ecol.

"A Pesticide Monitoring System with Special Reference to the Selection of Indicator Species"
pp 261-9.
In 'Pesticides in the Environment and Their Effects on Wildlife'
(Ed. N.W. Moore)

Supplement to Vol 3 of J. appl. Ecol. 1966

J.H. Keith
pp. 68 Raptors re/ft (Peregrine + Osprey)

James O. Keith

Ames. pp87 – Osprey eggs. DDT
Prestt pp107 Barn Owl (U.K.)

Barnard pp 193 – 8

"DDT Residues in Avian Tissues"

Impt. ... levels determined in tissues.

DDA +

Victim of pheasant dying > 65 ppm

American Robins - > 50 ppm

not dying < 29 ppm.

* see below (ref.)

Walker pp 213 – 222

Storage effects on analysis results

?? metabolites formed on analysed - on sample analyses ???

seems OK check !.

* Henry + Johnson pp.

ASTM Insecticide Conf Atlanta + Mammalian Toxicology.

Confined brain death Dieldrin 16.3 ppm ave

impt re action of poison + pattern of redistribution.



LIBRARY
DEPT. OF FISHERIES & WILDLIFE

RECALL NOTICE

*"A bird in the mouth*
*is worth two in the bush"*

*(Little known oriental saga)*

IRRELEVANCIES ASIDE, COULD YOU PLEASE RETURN THESE BOOKS LOITERING ON YOUR SHELVES:

| | DATE DUE |
|---|---|
| Pesticides Appraisal | |
| 2. Jnl. of Applied Ecology: ~~No~~ Vol. 3. (1966) | 14.1.83 |
| 3. U.S. Dept. of Interior. F.A.W. Serv. | ..... |
| Special Scientific Report - Wildlife. | ..... |
| Nos. 119, 241, 245 | 20.1.83 |
| Pesticide Residue Reports | |

THANKING YOU

LIBRARIAN

24.3.83

BOB.

The following references were supplied by Reid Library (UWA)

1.) NORRIS, K R

Dissertation on the history, bionomics and control of pests of the Australian pastoral industry. Dr. of Science, 1968

2.) RICHARDS, K T

Study of the insect pest complex of the Ord River irrigation area. Master of Science, 1968

3.) BOFFEY, R R

Integration of ecologic and economic criteria for pest control: a dynamic model applied to selected apple pests in W. A. Master of Science & Agriculture, 1980.

4.) SCHNEIDER, B H

Analyse of insecticide extention. Bachelor of Science Hons. Degree, 1975

Elisabeth
H/O Library
16/12/82.

MODERN GOVERNMENT.
NOV | DEC 1969
Rm(R348)
173.

# PESTICIDES: both boon & hazard

rtainly, caution is paramount in using these modern control aids. Especially when their toxicity, sistence or concentration may pollute the environment or harm beneficial animals, birds, —or man himself.

**by William M. Upholt**



NSECTS AND OTHER PESTS that attack food and raw materials or spread diseases have been a problem man since early history. Paradoxically, man's success controlling pests and pest-related diseases has compounded the problem rather than solved it. As human populations expand and the economic demands of civiation multiply, more food and fiber are needed; this ed must be met by cultivation of single crops on large reages, a practice which favors the development of sts that feed on those crops.

Thus, the pest population increases with the human pulation, and efforts to control it must increase also.

Man has learned improved methods of combating e agents of famine, death, illness, malnutrition and scomfort. But his fight for dominance over his environment raises new dangers. He must learn to mane the environment in a true symbiosis. George Wald "The Origin of Life" in "Physics and Chemistry of ife," *Scientific American*, New York, 1955) has shown at blind dominance of any one form of life on earth ventually creates an environment that destroys that rm of life. Some ecologists believe that man's present ourse will lead rapidly to pollution of essential natural sources, with catastrophic effects on humanity. Although the danger may be exaggerated, most scientists cognize that pesticides must be used with caution.

A pesticide is used to kill, repel or otherwise interfere with the normal growth and/or reproduction of insects and other pests. Ideally, each pesticide would destroy one undesirable pest without endangering useful species, but this ideal is both physiologically impossible and expensive; it is more economical to control many pests with a single chemical.

In practice, decisions are made by comparing the benefits of control with the hazards of the means of control and choosing among alternatives.

Many factors must be considered: the degree of control needed for protection and to prevent rapid reinfestation, the amount of pesticide required for a given degree of control, its availability, ease of handling and application, monetary cost (total cost of material, equipment and labor to provide control for a specified time, rather than cost per kilogram only), and hazards to people, crops, domestic animals, wildlife and the total environment. Each factor comprises many aspects: the severity of the pest damage, the stability and persistence of the chemical, its toxicity to both target and non-target organisms, etc.

## Risk can be justified

Because of these many complex, interacting factors, no general decisions can apply to all situations. For example, where malaria is rare or non-existent, any un-

774/69 Vol 4
ff 110 – 15
Jim Baulch
Vic F&W Statement
on Residues
in Milk – Sapling –

Dieldrin & Polutes

John Edmonds

ref folio 169

774/69 Vol 3

Uni interest in Pesticides.

Also Vol 1 774/69

is Valuable re

General Information

[+ Ord Surv]

GOVERNMENT CHEMICAL LABORATORIES
30 Plain Street, Perth, Western Australia 6000
Telephone: 325 5544
Address all correspondence to the Director

83

Food 774/69 Vol 5
Pesticides Res
Ads Chem

OUR REF
YOUR REF 831/63
ENQUIRIES TO
14 November 1978 GD

...issioner of Public Health
...d Medical Services
...ublic Health Department
...0 Beaufort Street
PERTH, W.A. 6000

Attention: Mr. G. Kaiser

...IAL Four samples of water from Piesse...k Brook, marked as below.

No. 44164-7/78

...WHOM RECEIVED AND DATE Public Health Department on 1 November 1978.

...E OF EXAMINATION

| Marks | Lab.No. | DDT and metabolites | Dieldrin |
|---|---|---|---|
| | | µg/l | |
| 312 7 24/10/78 | 44164 | 0.034 | 0.012 |
| 313 8 24/10/78 | 44165 | 0.014 | 0.006 |
| 905 (7a) 31/10/78 | 44166 | 0.012 | 0.004 |
| 906 (8a) 31/10/78 | 44167 | 0.021 | 0.011 |

...o other common organochlorine or organophosphorus pesticides were ...etected.

...he levels of DDT and metabolites and dieldrin are well below the ...ecommended maximum values for public water supplies.

...H. GENOVESE
...HEMIST & RESEARCH OFFICER

...E. UREN
...HIEF
...OOD & INDUSTRIAL HYGIENE DIVISION

GOVERNMENT CHEMICAL LABORATORIES
30 Plain Street, Perth, Western Australia 6000
Telephone: 325 5544
Address all correspondence to the Director

85

OUR REF:
YOUR REF: PHD Ind
ENQUIRIES TO:

Frd 774 169 Vol 1

...issioner of Public Health
...edical Services
...epartment of Public Health
Occupational Health Division
57 Murray Street
PERTH 6000

29 November, 1978 GWD

Attention: Mr. W.H. Hoyle

MATERIAL: Eight samples of eggs from a poultry pen previously treated for flea control, marked as below.

LAB No. 44096-44103/78

FROM WHOM RECEIVED AND DATE: Department of Public Health on 1 November 1978

Pesticides Adv Cttee

RESULT OF EXAMINATION:

| Marks | Lab. No. | Dieldrin mg/kg (shell free) |
|---|---|---|
| - | 44096 | 2.9 |
| - | 44097 | 0.7 |
| - | 44098 | 4.5 |
| - | 44099 | 4.4 |
| - | 44100 | 7.0 |
| Brown bantam | 44101 | 3.8 |
| Black bantam | 44102 | 12.0 |
| Grey bantam | 44103 | 4.6 |

No other common organochlorine pesticides were detected in the samples.

The samples fail to comply with Regulation A.07.003 of the Food and Drug Regulations in that the level of dieldrin exceeds the maximum residue limit of 0.1 mg/kg.

G.F. EBELL
CHEMIST & RESEARCH OFFICER

F. E. UREN
CHIEF
FOOD & INDUSTRIAL HYGIENE DIVISION

Copy to: Dr. F. Hogworth
Department of Public Health

140

all egg samples fail to comply with Regulation A.07.003 of the Food and Drug Regulations Schedule 1 with respect to the permitted level of 0.1 mg/kg for dieldrin.

It is considered that this yard is unsuitable for use as a poultry pen.

J. H. GENOVESE
CHEMIST & RESEARCH OFFICER

F. E. UREN
CHIEF
FOOD & INDUSTRIAL HYGIENE DIVISION

Copy to: Dr. F. Heyworth

Department of Minos, Western Australia
GOVERNMENT CHEMICAL LABORATORIES
30 Plain Street, Perth, Western Australia 6000
Telephone: 325 5544

141
Fcw 774/69
Vol 5

Address all correspondence to the Director

OUR REF

YOUR REF: F.949/63 DJD:BC

ENQUIRIES TO

12 January, 1979 GWD

Pesticides Res Adv Cttee

missioner of Public Health
Medical Services
partment of Public Health
ccupational Health Division
7 Murray Street
ERTH 6000

tention: Mr. W.H. Moyle

even samples comprising 5 soils and 6 hen eggs from a yard at
1 Berwick Street, Victoria Park, marked as below.

638-44648/78

EIVED AND DATE Department of Public Health on 12 December 1978

NATION

rks:

il - One
Two under creeper
3 centre of number one yard
4 near castor oil tree
5 centre of 2nd yard

gs - None

| Sample | Lab. No. | Aldrin | Dieldrin |
|---|---|---|---|
| | | mg/kg | |
| Soils | | | |
| 1 | 44638 | 0.56 | 0.55 |
| 2 | 44639 | 0.22 | 0.40 |
| 3 | 44640 | <0.04 | 0.15 |
| 4 | 44641 | 0.54 | 1.3 |
| 5 | 44642 | 0.05 | 0.32 |
| Eggs | | | |
| - | 44643 | <0.04 | 5.5 |
| - | 44644 | <0.04 | 5.9 |
| - | 44645 | <0.04 | 5.4 |
| - | 44646 | <0.04 | 4.2 |
| - | 44647 | <0.04 | 4.0 |
| - | 44648 | <0.04 | 6.8 |

../2

Department of Mines, Western Australia
GOVERNMENT CHEMICAL LABORATORIES
30 Plain Street, Perth, Western Australia 6000
Telephone: 325 5544

(14 3)

Address all correspondence to the Director

774/69 Vol 1 Pesticides Res Adv Ctte

Director of Agriculture
Department of Agriculture
Jarrah Road
SOUTH PERTH W.A. 6151

Attention: Animal Health Lab.
for Mr. H. Masters

OUR REF

YOUR REF: 3497/78

ENQUIRIES TO

12 January, 1979 GWD

Four trace-back samples comprising three pastures and one soil from Mumballup, marked as below.

44512-44515/78

M RECEIVED AND DATE Department of Agriculture on 4 December, 1978

XAMINATION

| Marks: | Lab. No. | Dieldrin mg/kg (dry basis) |
|---|---|---|
| BY 1134/78 | | |
| 1. Creek bed green grass below pot. patch, house and 1/1 tele | 44512 | 0.30 |
| 2. Dry grass random above sources | 44513 | 0.001 |
| 3. Dry grass track | 44514 | <0.001 |
| 4. Creek bed soil | 44515 | 0.002 |

G. F. EBELL
CHEMIST & RESEARCH OFFICER

F. E. UREN
CHIEF
FOOD & INDUSTRIAL HYGIENE DIVISION

GOVERNMENT CHEMICAL LABORATORIES
30 Plain Street, Perth, Western Australia 6000
Telephone: 325 5544
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FDW 774/69 Vol 3 Particulars Adv CN

OUR REF
YOUR REF
ENQUIRIES TO
29 October 1979 PT

Commissioner of Public Health
& Medical Services
Department of Public Health
Occupational Health, Clean Air
& Noise Abatement
57 Murray Street
PERTH 6000

Attention : Mr. D.J. Dunn.

MATERIAL Four samples comprising three samples of soil and one sample of eggs from a property at Maddington

LAB. No. 42838-41/79

FROM WHOM RECEIVED AND DATE Department of Public Health on 24 September 1979.

RESULT OF EXAMINATION

| Sample | Lab No. | Aldrin | DDT and metabolites | Dieldrin | Heptachlor and metabolites |
|---|---|---|---|---|---|
| | | mg/kg | | | |
| Soil | | | | | |
| No. 1 | 42838 | 85 | <0.2 | 41 | 11 |
| No. 2 | 42839 | 21 | 0.7 | 3 | 0.5 |
| No. 3 | 42840 | 0.05 | 0.03 | 0.01 | <0.002 |
| Eggs | | | | | |
| No. 4 | 42841 | 0.02 | 0.15 | 0.17 | 0.02 |

The sample of eggs fails to comply with Regulation A.07.003 Schedule 1 of the Food and Drugs Regulations in that the level of dieldrin exceeds 0.1 mg/kg.

J.H. GENOVESE
CHEMIST & RESEARCH OFFICER

F.E. UREN
CHIEF
FOOD & INDUSTRIAL HYGIENE DIVISION

Copy to : Dr. F. Heyworth, P.H.D.

**GOVERNMENT CHEMICAL LABORATORI**
30 Plain Street, Perth, Western Australia 6000
Telephone: 325 5544
Address all correspondence to the Director

OUR REF:
YOUR REF:
ENQUIRIES TO:

Director
Department of Fisheries & Wildlife
W.A. Wildlife Research Centre
P.O. Box 51
WANNEROO 6065

Attention: Mr. G.B. Pearson
Technical Officer
Waterbird Research

MATERIAL: Two Spotted Pardalotes alleged to have been poisoned with heptachlor, marked: "9.3.78 Spencer Park School, Albany
From W.O. Smith, Albany"

LAB No 42917-18/78

FROM WHOM RECEIVED AND DATE: Department of Fisheries & Wildlife on 19/7/78

RESULT OF EXAMINATION:

| Lab. No: | 42917 | mg/kg | 42918 |
|---|---|---|---|
| Heptachlor | <0.002 | | <0.002 |
| Heptachlor epoxide | <0.001 | | 0.03 |

These low levels are not likely to have caused the death of the birds.

No other common organochlorine pesticides were detected.

L. P. CONTI
CHEMIST & RESEARCH OFFICER

W.R. Wood

W. R. WOOD
ACTING CHIEF
FOOD & INDUSTRIAL HYGIENE DIVISION

Pesticide Residues Ctee

GOVERNMENT CHEMICAL LABORATORIES

30 Plain Street, Perth, Western Australia 6000

Telephone: 25 5544

Address all correspondence to The Director

FAW 774/69 Vol 4

Commissioner of Public Health &
Medical Services
Department of Public Health
Occupational Health Division
57 Murray Street
PERTH WA 6000.

19 April 1978. CC.

Attention: Mr. D.J. Dunn.

Pesticides Review
Ads Otter

OUR REF:

YOUR REF DJD/MT.

ENQUIRIES TO:

MATERIAL: One sample of domestic fowl from Upper Swan, marked: "Domestic Fowl (suspect poisoning) 115 Railway Pde, Upper Swan From OHD".

LAB No. 40786/78.

FROM WHOM RECEIVED AND DATE: Department of Public Health on 30/3/78.

RESULT OF EXAMINATION

The kidneys were examined for the presence of arsenic, and samples of fatty tissue and liver were examined for the presence of organochlorine pesticides.

| | Arsenic | Dieldrin |
|---|---|---|
| | mg/kg | |
| Kidney | 0.29 | - |
| Fatty tissue | - | 63 |
| Liver | - | 43 |

No other common organochlorine pesticides were detected.

A.W. Nicholson

A.W. NICHOLSON
CHEMIST & RESEARCH OFFICER.

F.E. Uren

F.E. UREN
CHIEF
FOOD AND INDUSTRIAL HYGIENE DIVISION.

# GOVERNMENT CHEMICAL LABORATORIES

30 Plain Street, Perth, Western Australia 6000

Telephone: 25 5544

Address all correspondence to The Director

Commissioner of Public Health
and Medical Services
Department of Public Health
57 Murray Street
PERTH. 6000

4 April 1978 MB

Attention: Mr. D. J. Dunn.

FW 774/69 Vol 4 Pesticides Aerial Adv Cttee

OUR REF:

YOUR REF: DJD/MT

MATERIAL: Six samples comprising three soil, leaves, hen eggs and vomit from Lot 115 Railway Pde, Upper Swan marked: Soil "Chicken Pen. Front fence". "Chicken Pen. Back fence". "Back Paddock". Leaves- none. Hen eggs - none. Hen vomit - "Bile from dying hen".

LAB. No. 40663-68

WHOM RECEIVED AND DATE: Department of Public Health on the 9/3/78.

RESULT OF EXAMINATION:

| Sample | Lab. No. | Arsenic, As | Aldrin | Dieldrin |
|---|---|---|---|---|
| | | | mg/kg | |
| Soil: Front fence | 40663 | 1.0 | 120 | 18 |
| Back fence | 40664 | 1.0 | 12 | 10 |
| Back paddock | 40665 | 0.29 | 0.03 | 0.09 |
| Leaves | 40666 | 0.26 | 0.04 | 0.27 |
| Eggs | 40667 | 0.09 | 0.08 | 28 |
| Vomit | 40668 | 1.6 | 0.12 | 0.18 |

No other common organochlorine pesticides were detected.

It is noted that the higher arsenic concentrations in the soils are coincident with the higher aldrin concentrations i.e. from the chicken pen area.

The arsenic could be the residue of arsenical pesticides applied in time past to the vines. It could also result from the use of an arsenical weedkiller to clear the site for building.

The aldrin could be present as the result of a standard anti-termite treatment of the building site.

The high concentration of dieldrin in the hen eggs indicates that the hens are probably absorbing aldrin by pecking soil particles from the chicken pen.

F. E. UREN
CHIEF
FOOD AND INDUSTRIAL HYGIENE DIVISION

A. W. NICHOLSON
CHEMIST & RESEARCH OFFICER

# GOVERNMENT CHEMICAL LABORATORIES

30 Plain Street, Perth, Western Australia 6000

Telephone: 25 5544

Address all correspondence to The Director

Fwd 774/69 Vol 4

Pesticides Residue Adv Ctee

Commissioner of Public Health
and Medical Services
Department of Public Health
57 Murray Street
PERTH. 6000

Attention: Mr. W. H. Moyle.

10 March 1978 MB

OUR REF

YOUR REF WHM/MT

MATERIAL: Two samples of soil from M. G. Kingman's poultry pen as below.

LAB No 40643-4/78

OM RECEIVED AND DATE Department of Public Health on the 7/3/78.

RESULT OF AMINATION

| Marks | Lab. No. | Aldrin | Dieldrin |
|---|---|---|---|
| | | ----- mg/kg ----- | |
| G. Kingman Soil 3/3/78 | | | |
| Sample A Poultry pen under passion vine | 40643 | 3.0 | 1.2 |
| Sample B Poultry pen near arc mesh gate | 40644 | 1.0 | 0.31 |

M N Hoare

M. N. HOARE
CHEMIST & RESEARCH OFFICER

for W.R.Wood
F. E. UREN
CHIEF
FOOD AND INDUSTRIAL HYGIENE DIVISION

copy to: Dr. F. Heyworth.

30 Plain Street, Perth, Western Australia 6000

Telephone: 25 5544

Address all correspondence to The Director

Commissioner of Public Health
and Medical Services
Department of Public Health
Occupational Health Division
57 Murray Street
PERTH 6000

3 March 1978 CD

Attn: Mr. W.H. Moyle

F&W 774/65 Vol 4 Pesticides Residues Adv Cttee

OUR REF:

YOUR REF WHM/MT

ENQUIRIES TO:

MATERIAL: One sample of fowl from G. Kingman's property, as below.

LAB No 40401/78

FROM WHOM RECEIVED AND DATE Department of Public Health on 17 February 1978.

RESULT OF EXAMINATION:

| Sample | Wet weight g | Dieldrin mg/kg |
|---|---|---|
| Fatty tissue from breast | - | 11 |
| Heart (whole) | 4.6 | 57 |
| Kidneys (whole) | 3.7 | 42 |
| Liver (whole) | 16.4 | 180 |

A. W. Nicholson
A. W. NICHOLSON
CHEMIST & RESEARCH OFFICER

F. E. Uren
F. E. UREN
CHIEF
FOOD & INDUSTRIAL HYGIENE DIVISION

Copy to Dr. F. Heyworth.

# ORGANOCHLORINE PESTICIDES IN THE ENVIRONMENT

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
Special Scientific Report--Wildlife No. 119

Water - Seam
→ FAUNA RESEARCH

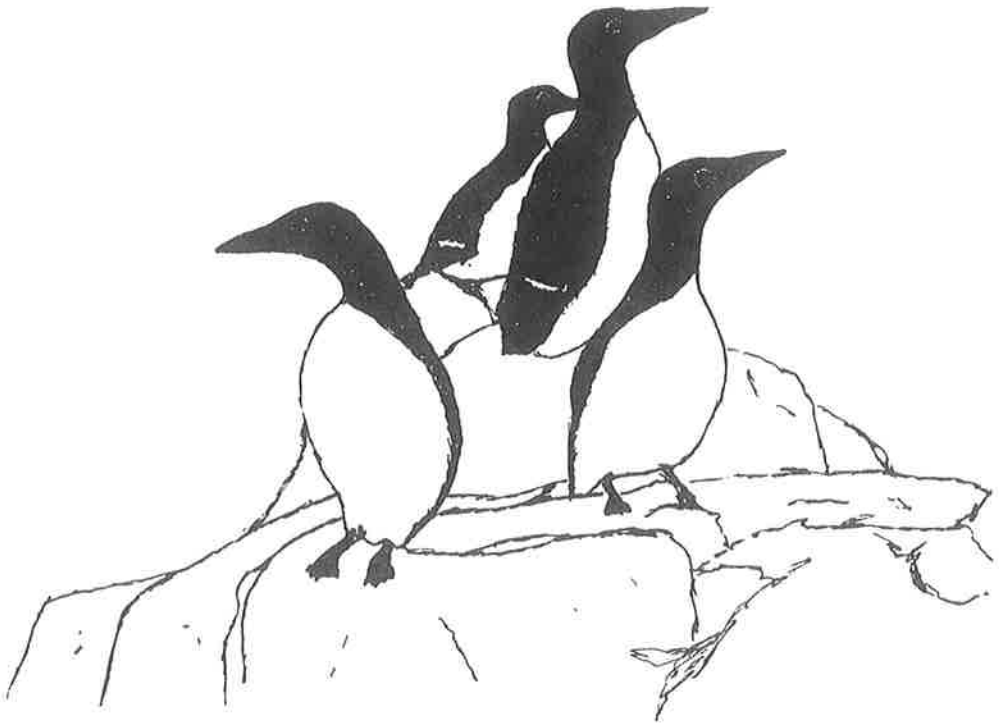
# RESIDUES OF DDT, DIELDRIN, AND HEPTACHLOR IN EARTHWORMS DURING TWO YEARS FOLLOWING APPLICATION

FISHERIES AND
WILDLIFE
28 JUN 1982
LIBRARY

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Special Scientific Report – Wildlife No. 241

FISHERIES AND WILDLIFE
21 SEP 1982
LIBRARY

# ORGANOCHLORINE RESIDUES IN EGGS OF ALASKAN SEABIRDS



UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Special Scientific Report – Wildlife No. 245

R. HUDSPETH

# Ecological significance of Territory in the Australian magpie, *Gymnorhina tibicen*

by

Robert Carrick

Reprinted from The Proceedings XIIIth International Ornithological Congress, 1963
pp.740-753

THE DIRECTOR,
Government Chemcial Laboratories,
64 Adelaide Terrace,
PERTH. 6000. W.A.

Mr. Prince.

13th July, 1971.

ATTENTION: Mr. Houghton

Herewith six bottles containing numbered liver and muscle specimens from magpies (Gymnorhina dorsalis) collected in the South West over the period 3rd - 10th July last.

Could you please arrange analysis for organo-chlorine pesticides as discussed previously in each sample. This batch of samples may also be tested for the presence of organo phosphate pesticides as you think necessary.

Further samples from this series of specimens are being retained in cold storage at our Hay Street Laboratory pending your advice on when they may be accomodated for analysis.

This series comprises 133 samples in all, collected from 63 magpies and three 'crows' (unidentified).

B.K. BOWEN.
(Director)

T.A.K. - for your notes

THE DIRECTOR:

I recently discussed the question of time involved in pesticide residue analysis with Mr. Houghton, Chief of Division, Food, Drugs, and Toxicology in the Government Chemical Labs. and Mr. Ebell (one of the analysts). On the basis of our magpie sampling programme where we have taken muscle and liver samples only, 30 individual tissue samples (or the equivalent of 15 birds) per week would be the limit for one man. At this rate and assuming that capital items at the Chem Labs were not limiting, the employment of an additional analyst to do pesticide residue analysis for our work only could allow for a maximum throughput of approximately 1,000 samples per year.

We have submitted approximately 250 samples for analysis since the beginning of January, the majority (approx. 200) being submitted since May. We also have another 100 samples in storage which have not been submitted for analysis.

It is easily appreciated that any practicable residue monitoring programme which we could sustain under these conditions will be limited. The major difficulty arises at the point of analysis.

In my opinion the magpie sampling programme can provide us with data an distribution and level of residue contamination, and should be expanded to cover the whole of the agricultural areas of the State. I believe Victoria is also using magpies as indicator species for this purpose.

To obtain adequate sample coverage of this area would require collection of 3-400 birds per annum. On the basis of sampling carried out so far by Mr. McWhirter these could be collected over 40-50 working days in the field (i.e. 8-10 weeks). The collection of samples is quite practicable from our point of view with our present staff but if we are to consider this work then there appears to be a need for an additional analyst in the Chem Labs to cope with the volume of work which will be required.

It is my suggestion that we should be able to assist Mr Houghton to prepare a submission for the P.S.B. so that an additional analyst could be employed for this purpose.

R.Prince.
-6-9-1971-

R. Prince
WLRC

The Librarian
Department of Fisheries and Wildlife
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PERTH WA 6000

Reports on Eggshells thing

Duck drugs analysis

COMMONWEALTH OF AUSTRALIA
If not delivered within 7 days, return to
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*Aust. Wildl. Res.*, 1980, 7, 139–47

BOB PRINCE

# Organochlorine Residues in Wings of Ducks in South-Eastern Australia

*Penny Olsen*,[A] *H. Settle*[B] *and R. Swift*[B]

[A] Division of Wildlife Research, CSIRO, P.O. Box 84, Lyneham, A.C.T. 2602.
[B] Australian Government Analytical Laboratories, Regional Laboratory (South Australia), 344 Tapleys Hill Road, Seaton, S.A. 5023.

*Abstract*

Wings of 12 species of waterfowl from all of 10 sites in south-eastern Australia contained organochlorine pesticides, DDE being the predominant residue. Total DDT ranged from 0·03 to 316·10 ppm wet weight in individual Pacific black duck, *Anas superciliosa*, wings and from 0·02 to 15·10 ppm in pooled samples of wings from each species. Highly significant positive correlations were found between total DDT residues in the wing and those in livers, brain, breast muscle and fat of individual Pacific black duck.

## Introduction

Residue levels in the wings of waterfowl have been found in the United States to be sensitive indicators of general environmental contamination by organochlorine pesticides. Heath and Prouty (1967) first proposed that residues detected in the wings of mallard *Anas platyrhynchos* and black duck *Anas rubripes* could be used for the monitoring of pesticides; the finding by Dindal and Peterle (1968) of significant correlations between residues in wings and those in body tissues and organs supported the use of wings for this purpose. Subsequently, Heath (1969) collected baseline data for future comparison and a monitoring program has been carried out at 3-yearly intervals (Heath and Hill 1974; White and Heath 1976).

Duck hunting is well established in south-eastern Australia and regular surveys (Braithwaite and Norman 1974, 1976, 1977) provide the opportunity to obtain wings. The main species chosen for study, the Pacific black duck *Anas superciliosa*, is abundant and geographically widespread and is closely related to the two species used in the U.S. program.

In Australia DDT has been used in pest control since 1946 (Australian Academy of Science 1972). DDE, a metabolite of DDT, has been shown to cause eggshell thinning and reproductive impairment in mallards and (U.S.) black ducks (Heath *et al.* 1969; Longcore *et al.* 1971; Longcore and Stendell 1977). Thus any residues found in the wings may be indicative of possible reproductive effects on the ducks and are also of concern because most waterfowl shot by hunters are eaten.

## Methods

### *Sampling Procedure and Preparation*

Duck wings (one wing from each duck) were collected in March 1977, and Pacific black duck wings were pooled for each of the 10 sites surveyed (Fig. 1). An attempt was made to pool wings

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BOB PRINCE

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# EGGSHELL THINNING AND ORGANOCHLORINE RESIDUES IN EGGS AND PREY OF PEREGRINE FALCONS FROM VICTORIA, AUSTRALIA

STEPHEN G. PRUETT-JONES[1], CLAYTON M. WHITE[1] AND WILLIAM B. EMISON[2]

[1]*Department of Zoology, 574 WIDB, Brigham Young University, Provo, Utah 84602, USA.* Present address for SGP-J: *Museum of Vertebrate Zoology, 2593 LSB, University of California, Berkeley, California 94720, USA.*
[2]*Fisheries and Wildlife Division, Arthur Rylah Institute for Environmental Research, 123 Brown Street, Heidelberg, Victoria 3084, Australia.*

## SUMMARY

PRUETT-JONES, S. G., C. M. WHITE AND W. B. EMISON. 1981. Eggshell thinning and organochlorine residues in eggs and prey of Peregrine Falcons from Victoria, Australia. Emu 80:281-287.
The Peregrine Falcon in Victoria is common for a raptor, breeds in most habitats and at a variety of sites and has moderate reproductive success. However, breakage of eggs, loss of clutches and abnormal behaviour of some adults are salient characteristics of the population. Between 1975 and 1977 we collected thirty-five eggs from twenty-six eyries and forty-three individuals of thirteen species of prey for analysis of chlorinated hydrocarbons. Eggshell index averaged 1.52, indicating a 20.4 per cent reduction in shell index from eggs collected before 1952. DDE content of eggs ranged from 2.30–82.00 ppm wet weight (mean 17.63). Polychlorinated Biphenyls and Dieldrin were present in most eggs but at low levels. Residues of DDE for prey were low (mean 0.11 ppm) but were highest for two of the most important species in the diet of the Peregrine: Feral Pigeon and Common Starling. Despite rather low use of DDT in Victoria, residues in important prey, specially the Pigeon, are sufficiently high to produce the reproductive failure observed. The significance of this failure to the population of Peregrines is unclear. Its apparent stability probably results from a large population in the past; a future population reduction may occur if eggs continue to be lost at the present rate.

## INTRODUCTION

Organochlorine insecticides are well known as persistent toxins to birds of prey throughout the world. Significant residues of chlorinated hydrocarbons, notably DDT and its derivative DDE, have been found in raptors from every geographical region (Hickey 1969; Anderson and Hickey 1972, 1974; Ratcliffe 1973; Walker *et al.* 1973; Peakall and Kemp 1976; Frank *et al.* 1977; Fox and Lock 1978). The effects of organochlorines on avian reproduction are reviewed by Heath *et al.* (1970), Jeffries (1973), Peakall (1973) and Newton (1979). For raptors, they include direct mortality, abnormal behaviour through alteration of levels of steroid hormones, reduced weight and thickness of eggshells through inhibition of calcium deposition, increased breakage of eggs and increased death of embryos and failure to hatch (see also Ratcliffe 1967; Porter and Wiemeyer 1969; Reichel *et al.* 1969). Raptors are known to be particularly sensitive to pesticides because residues accumulate through the food chain (Hickey and Anderson 1968; Newton 1979). Moreover, at a given level of concentration, pesticides have a greater effect on raptors than they have on other groups of birds, most noticeably galliformes, columbiformes and passeriformes (Heath *et al.* 1969; Hunt and Sacho 1969; Peakall 1970; Longcore *et al.* 1971; Jeffries 1973; Peakall *et al.* 1973; Risebrough and Anderson 1975).

Reproductive failure, induced by DDT, has been shown to be significant in declines of the Peregrine Falcon *Falco peregrinus* in Europe and North America (Cade 1960; Hickey 1969; Ratcliffe 1973). In the United States the extinction of eastern, and the severe decline of western, populations is well documented (Herbert and Herbert 1965; Hickey 1969; Cade and Fyfe 1970; Enderson and Craig 1974; Porter and White 1973). Western populations have become stable and some recovery has been made after the ban of DDT in 1971 throughout the continent. However, the highly migratory population (*tundrius*) continues to decline because of pesticides picked up in South America during winter (Cade *et al.* 1971; Fyfe *et al.* 1976). A non-migratory population of Peregrines (*pealei*) in the Aleutian Islands (White *et al.* 1973) was found to be relatively stable. In Great Britain a population of about 700 pairs, stable for many years, declined by sixty per cent between 1956 and 1963 (Ratcliffe 1973). By 1971 (after reduction of use of DDT) it had begun to recover, approaching nearly 600 pairs, although production of young was still low.

In this paper we present data on the thinning of eggshells and on pesticide residues in the eggs and prey of the Peregrine population (*macropus*) in Victoria, Australia. The use of DDT in Australia continues in some agricultural areas but is generally low; at its peak, use was only about one-twentieth of the amount previously used during peak periods in the United States (Aust. Acad. Sci. 1972). Despite attempts to establish baseline residue levels for wildlife in Australia (Butcher 1965; Best 1973), the question of whether the present levels of DDT application are sufficient to interfere with the reproduction of resident raptorial birds remains unanswered. In this study we have examined this question as it relates to the distribution and population ecology of Peregrines in Victoria.

## METHODS

Survey work on Victorian Peregrines was conducted

BOB PRINCE

Royal Australasian Ornithologists Union

Edited by Gina O'Donoghue

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# DDT: PEREGRINES IN PERIL?

**Is the Victorian population of peregrine falcons heading for a "crash"? Maybe so, according to this provocative review prepared for the RAOU by JENNY and JERRY OLSEN. The sad fact (they say) is that, "on a world-wide scale, DDT production and use is greater than it ever was, and is increasing".**

Since the second World War the chemical control of pests has become widespread. Over 200 registered, active ingredients now form the basis of an ever increasing number of pesticide formulations. Some of the pesticides now in use cause heavy mortality to wildlife. This is usually in a localised area, but because they rapidly break down to harmless compounds, often there is no lasting effect. One group of pesticides, the organochlorines, has done the most harm to wildlife. Because they have great chemical stability and are stored in fat, the organochlorines can persist in the environment, accumulate through food chains and may be carried far from the site of application. Not only are they toxic to wildlife but, in sublethal amounts, they have caused massive reproductive failure in some bird species.

DDT (and its metabolites) have been found in a great range of our wildlife. Since it is often present in amounts sufficient to cause shell-thinning and lowered productivity in raptors, this article will deal primarily with DDT.

DDT was first used as an insecticide in World War II. Since the war it has been widely used in agriculture and in malarial mosquito control programs. Because of its relatively low toxicity to higher vertebrates and effectiveness against many insect pests, for many years it seemed the ideal pesticide and its insidious effects on wildlife went largely unrecognized.

The British ornithologist Derek Ratcliffe was the first to discover the phenomenon of DDT-induced egg-shell thinning. In the early 1960's, as a result of vigorous lobbying by pigeon racers concerned about depredations of peregrines *Falco peregrinus* on their flocks, Ratcliffe was asked to survey the peregrine population of Britain. The pigeon racers' concern that the peregrine population was increasing proved to be unfounded. Ratcliffe found that the peregrine was in dire trouble, had all but disappeared from southern England,



and was decreasing elsewhere. He later showed that breakage of abnormally thin-shelled eggs in the nest was causing massive reproductive failure. He devised a thickness index (weight of the blown egg, in mg, divided by the length times the breadth, in mm.) that allowed comparison of eggs in old collections with those collected more recently, and was able to show that sudden decreases in shell-thickness were linked with the widespread introduction of DDT to agriculture.

By 1970 the serious decline and even extinction of peregrine populations on two continents was apparent, as was the circumstantial evidence implicating DDE, the main breakdown product of DDT. Much of the resultant controversy and increase in research in raptors passed Australia by. Although the exact means of action of DDE is still unknown, there is now no reasonable doubt that it causes egg-shell thinning in raptors. There is a mass of circumstantial evidence from many species in many parts of the world, and much careful corroborative research from the laboratory. No arguments to the contrary has withstood scrutiny and no alternative explanation has been substantiated. Nevertheless, a few people remain unconvinced, often because of a lack of understanding of the complexities involved. It therefore seems appropriate to outline the main evidence:

(1) widespread eggshell thinning and reproductive failure are unprecedented in ornithological history;

(2) shell thinning and declines in productivity are closely associated with the introduction of DDT use, and recoveries are associated with restrictions or withdrawal of DDT use;

(3) shell thinning and population declines are closely associated geographically with DDT use, and are greatest in areas where DDT use is and has been greatest;

(4) DDE residues in fresh eggs are closely correlated with shell thinning and reproductive success in both the laboratory and the field.

(5) analysis of extracts from the remaining membrane in previously blown eggs has shown that DDE was not present in any eggs collected before 1946, but was present in many eggs collected since that time in amounts correlated with shell thickness;

(6) in the field DDE is present in raptors and in their prey in amounts sufficient to cause shell-thinning and reproductive failure in raptors.

(7) raptors are physiologically more sensitive to the effects of DDE than are other families of birds, for example, 4-5 ppm (wet weight) DDE in the fresh egg of a raptor is associated with about

*(Continued page 2)*

**ABBOTTS BOOBY**

**The RAOU is concerned at the delay in announcing protection measures for the Abbotts Booby. Last Newsletter contained a detailed report by Prof. Mike Cullen on the conservation needs of this endangered seabird, which nests over phosphate reserves on Christmas Island. The Australian Government was due to decide on conservation recommendations by last May — but as yet no decision has been announced. The RAOU hopes this does not indicate that the future of Abbotts Booby is in jeopardy.**

JAK LANE

# SOME ORGANOCHLORINE PESTICIDE RESIDUES IN WILDLIFE OF THE NORTHERN TERRITORY, AUSTRALIA, 1970–71

By SUSAN M. BEST*

[Manuscript received 1 March 1973]

*Abstract*

A survey was made, during 1970 and 1971, of organochlorine pesticide residues in the fatty tissues of 12 mammal, 4 bird, 10 reptile, and 6 fish species collected from areas defined as undeveloped and developed of both the arid and tropical zones of the Northern Territory. Pooled samples were taken of most species. Where possible, each species was sampled from each of the four areas.

Most samples from undeveloped areas had no detectable organochlorine residues. Residues were found in only 38% of samples from the arid undeveloped area and in 41% of samples from the tropical undeveloped area. The majority of samples from developed areas, both arid and tropical, contained organochlorine pesticide residues.

Eight organochlorine compounds were detected. In order of frequency of detection these were DDE, DDT, dieldrin, HCB, DDD, lindane, endrin, and aldrin. Polychlorinated biphenyls were not determined.

Possible sources of these organochlorine residues are discussed, and suggestions about the selection of animal species for future monitoring studies are made.

## I. INTRODUCTION

Monitoring studies of organochlorine residues in terrestrial and aquatic wildlife from areas remote from direct influence by man have been made in many countries including U.S.A. (e.g. Greenwood *et al.* 1967), Canada (e.g. Brown and Brown 1970), Antarctica (e.g. Sladen *et al.* 1966), U.K., Ireland, Norway, Sweden, Finland, Netherlands, Spain, and Portugal (e.g. Holden 1970). Organochlorine compounds found were pesticide residues such as DDT and dieldrin, and polychlorinated biphenyls associated with industry (Holmes *et al.* 1967; Peakall and Lincer 1970).

No nation-wide pesticide monitoring programme exists in Australia, but the Department of Fisheries and Wildlife is conducting a state-wide programme in Victoria. Additionally, some pesticide residue studies are being carried out on certain animal species by the Division of Wildlife Research, CSIRO, Canberra, by the New South Wales Department of Agriculture in conjunction with the N.S.W. National Parks and Wildlife Service, by the Department of Primary Industries, Queensland, and by the Departments of Fisheries and Fauna in South Australia and Western Australia. Butcher's report (1965) of levels of DDT and dieldrin in

* Animal Industry and Agriculture Branch, Department of the Northern Territory, Darwin, N.T. 5790.

900/69

FPAct

Pesticides.

Analysis of Wildlife

# THE JOURNAL OF APPLIED ECOLOGY

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VOLUME 3

1966

AND SUPPLEMENT

## PESTICIDES IN THE ENVIRONMENT AND THEIR EFFECTS ON WILDLIFE

EDITED BY

N. W. MOORE

BLACKWELL SCIENTIFIC PUBLICATIONS · OXFORD
1966

# Effects of pesticides on wildlife

By N. W. Moore

*Monks Wood Experimental Station, Abbots Ripton, Huntingdon*

## Introduction

Most of the research on the effects of pesticides on wildlife has been done in order to reduce harmful side effects, that is by scientists interested in conservation. Since the approach of conservation ecologists is conditioned by the aims of their work these should be mentioned, for, unlike the aims of agriculture and preventive medicine, they cannot be taken for granted. This is unfortunate because conservation is, I believe, an important and probably an essential activity of modern man. Essentially the aim of conservation is to hand on biological diversity to future generations. The reasons for this are:

1. We never know when a particular species may not become of particular value to man in the future; once a species becomes extinct it is lost for ever.
2. Biological diversity produces stability; and in a general sense a stable total environment is better for mankind than an unstable one.

The important corollary from the point of view of today's discussion is that conservationists are primarily concerned with the survival of species. In this their approach is radically different from that of medical and veterinary experts who are primarily concerned with the survival of individuals. One of the main practical results of the difference is this—for medical purposes, toxicological data provide a reasonable basis for predicting the hazards of pesticides; but for the conservationist they are inadequate unless supplemented by data obtained in the field. The concern of the conservationist with populations conditions his whole approach to the problem of pesticides; but I believe it forces him into looking at it fundamentally, for the essential pesticide problems are ones of population ecology. In this paper I shall describe the nature of the subject in ecological terms before briefly summarizing research which is being done to elucidate some of the wildlife problems.

## The nature of pesticide effects

Most communities of wild plants and animals are complex, and most population changes in them are relatively gradual. Agriculture changes complex stable systems into simple unstable systems. When a species in the crop ecosystem increases rapidly and affects the economic yield of the crop we call it a pest. Pesticides are chemical agents used to destroy pests, both plant and animal. As well as being used in man-made monocultures against agricultural pests, they are also used against vectors of disease in both simple and complex environments. I shall confine my remarks to the effects of agricultural pesticides since the use of toxic chemicals in preventive medicine in Britain is relatively small.

In considering the effects of pesticides from the scientific point of view as opposed to the commercial, it is essential to realize that while a pesticide is used



Proceedings of the Royal Society.
Series B, No. 1007, Vol. 167.
21 February, 1967.

PESTICIDE RESIDUES
ANALYSES.

TWINBROOK CRYSTAL LAB

North of Perth

Bird

| SampleDate No | Collecting LocaAgBodya | Length Collected | Weight | Habitat type |
|---|---|---|---|---|
| 75 | Aug-71 | Mingenew @ 2+ 315g | 42.0cm | Farmland |
| 76 | Aug-71 | Mingenew @ 2+ 275g | 40.5cm | Farmland |
| 80 | Aug-71 | Mingenew @ 1+ 275g | 42.0cm | Farmland |
| | Dec-70 | Marchagee ? ? ? | ? | Farmland |
| | Dec-70 | Watheroo ? ? ? | ? | Farmland |
| | Dec-70 | Guilderton ? ? ? | ? | Farmland |

Perth urban area

Donnelly

| | | | | | | |
|---|---|---|---|---|---|---|
| Bird | | Dec-71 | Claremont ? ? ? | ? | Home Garden | |
| | 123 | Oct-72 | Metro area @ Adul[355g] (Whiteback) | 41.0cm | Urban | |
| | 126 | Oct-72 | Como @ Adul[350g] [4+] | 43.0cm | Urban | |
| | 129 | Oct-72 | Morley @ Adul[325g] [4+] | 40.0cm | Urban ?[fringe] | |
| | 134 | Oct-72 | Como ?? ?1+ [375g] | 44.0cm | Urban | |
| | 140 | Oct-72 | Willetton? ? 2+ [245g] | 41.5cm | Urban | |
| | 141 | Oct-72 | Viveash @ Adul[355g] [3+] | 40.7cm | Urban fringe | |
| | 143 | Oct-72 | Viveash @ 1+ [340g] | 39.5cm | Urban fringe | |
| | 142 | Oct-72 | Metro area @ Adul[340g] | 38.0cm | ?Urban fringe | 0.5 |
| | 144 | Oct-72 | North Beach @ Adul[330g] | 39.0cm | Urban | |

| | | | | | |
|---|---|---|---|---|---|
| | 145 | Oct-72 | Morley @ Adul[375g] | 42.0cm | Urban fringe |
| | 146 | Oct-72 | Balga @ Adul[335g] | 43.5cm | Urban fringe |
| | 125 | Nov-72 | Metro area @ 2+ [355g] | 40.0cm | Urban |
| | 128 | Nov-72 | Cloverdale @ 1+ [285g] | 37.0cm | Urban |
| | 122 | Apr-73 | Scarborough @ Adul[325g] | 42.5cm | Urban (fringe) |

---

Orchards and Forest:
Area E of Perth

| | | | | | |
|---|---|---|---|---|---|
| | 1 | Jun-71 | Pickering Brook @ 0+ ? | 42.0cm | Forest |
| | 2 | Jun-71 | Pickering Brook @ 1+ ? | 39.5cm | Forest |
| | 111 | Feb-72 | Karragullen @ 0+ 295g | 40.5cm | Orchards |
| | 112 | Feb-72 | Karragullen @ 1+ 305g | 42.0cm | Orchards |
| | 113 | Feb-72 | Pickering Brook @ >4 yr330g | 43.0cm | Orchards |
| | 114 | Feb-72 | Pickering Brook @ 1+ 290g | 39.5cm | Orchards |
| | 115 | Feb-72 | Hacketts Gully @ 2+ 295g | 39.5cm | Orchards |
| | 116 | Feb-72 | Hacketts Gully @ 1+ 265g | 40.5cm | Orchards |
| | 117 | Feb-72 | Mundaring Weir @ 0+ 295g | 43.0cm | Forest/Orchard |
| | 118 | Feb-72 | Pickering Brook @ >>4 335g | 42.5cm | Orchard |

---

Armadale-Serpentine

| | | | | | |
|---|---|---|---|---|---|
| | 67 | Jul-71 | Armadale @ 2+ 285g | 41.5cm | Pasture |
| | 68 | Jul-71 | Armadale @ 2+ 265g | 38.5cm | Pasture |
| | 69 | Jul-71 | Byford @ >4 270g | 43.0cm | P |
| | 70 | Jul-71 | Byford @ 2+ 320g | 41.5cm | P |
| | 73 | Jul-71 | Serpentine @ 3+ 308g | 38.5cm | P |
| 110(136) | | Feb-72 | Serpentine @ 2+ 260g | 37.5cm | P |
| | 147 | Oct-72 | Byford @ Adul[300g] | 39.5cm | Townsite |

---

Keysbrook-Dwellingup-

Pinjarra-Mandurah-
Waroona

| | | | | | |
|---|---|---|---|---|---|
| | Dec-70 | Greensland Rd, Pinjarra | ? ? ? | ? | P |
| 120 | Feb-71 | Greensland Rd, Pinjarra | ? 0+? [285g] | 38.5cm | P |
| | Dec-70 | Robert Bay, Peel Inlet | ? ? ? | ? | P |
| 119 | Feb-71 | Heron Point area, Harvey Estuary | @ 2+ [335g] | 42.0cm | P |
| | Dec-70 | SE Corner, Harvey Estuary | ? ? ? | ? | P |
| | Feb-71 | Mandurah district | ? ? ? | ? | P |
| 121 | Feb-71 | Mandurah district | @ 3+ [370g] | 41.5cm | P |
| | Dec-70 | Lakeside area Mandurah district | ? ? ? | ? | P |
| 3 | Jul-71 | Pinjarra | @ >4 290 | 39.5cm | P |
| 5 | Jul-71 | Waroona | @ >4 290 | 42.0cm | P |
| 6 | Jul-71 | Waroona | @ 4 290 | 40.5cm | P |
| 8 | Jul-71 | Yarloop | @ 5 325 | 42.5cm | P |
| 65 | Jul-71 | Isandra (Dwellingup) | @ 2+ 300 | 39.0cm | P |
| 66 | Jul-71 | Coolup | @ 1+ 295 | 41.0cm | P/B |
| 71 | Jul-71 | North Dandalup | @ >4 303 | 42.5cm | P |
| 72 | Jul-71 | North Dandalup | @ 2+ 305 | 43.5cm | P |

---

Waterloo-Dardanup-
Capel

| | | | | | |
|---|---|---|---|---|---|
| 10 | Jul-71 | Waterloo | @ 2+ 290 | 39.5cm | Pi |
| 11 | Jul-71 | Dardanup | @ <4 325 | 42.5cm | Pi |

| | | | | | |
|---|---|---|---|---|---|
| 12 | Jul-71 | Dardanup | @ 2+ 310g | 39.5cm | P/b |
| 19 | Jul-71 | Capel | @ 2+ 290g | 41.5cm | P |
| 139 | Oct-72 | Capel | @ Adul[360g] (>4) | 42.0cm | Townsite |

---

DonnybrookÿDistrict

| | | | | | |
|---|---|---|---|---|---|
| 16 | Jul-71 | Lowden | @ ò5+ 295g | 41.0cm | P |
| 17 | Jul-71 | Donnybrook | @ 2+ 295g | 41.0cm | P/Orchard |
| 18 | Jul-71 | @15 km SW of Donnybrook | @ 2+ 260g | 41.0cm | P |

---

Busselton-Augusta

| | | | | | |
|---|---|---|---|---|---|
| 20 | Jul-71 | Busselton | @ 0+ 270g | 39.5cm | P |
| 21 | Jul-71 | Carbunup or Marybrook | @ 0+ 310g | 41.5cm | P |
| 22 | Jul-71 | Carbunup or Marybrook | @ >4 310g | 42.0cm | P |
| 23 | Jul-71 | Yallingup | @ 0+ 280g | 41.5cm | Forest |
| 24 | Jul-71 | Yallingup | @ 2+ 335g | 40.5cm | P/F |
| 25 | Jul-71 | Mammoth Cave | @ 2+ 315g | 42.0cm | Forest |
| 26 | Jul-71 | Mammoth Cave | @ 2+ 315g | 43.0cm | Forest |
| 27 | Jul-71 | Alexandra Bridge | @ >4 300g | 43.0cm | P/F |

---

Nannup-Mullalyup-BoyupÿBrook-Manjimup-Pemberton

| | | | | | |
|---|---|---|---|---|---|
| 28 | Jul-71 | Nannup | @ ò2+ 300g | 39.5cm | P/F |
| 29 | Jul-71 | W of Bridgetown | @ 1+ 240g | 39.5cm | P |

| | | | | | |
|---|---|---|---|---|---|
| 30 | Jul-71 | W of Bridgetown | @ 4+ 300g | 41.0cm | P |
| 31 | Jul-71 | Balingup | @ >4 305g | 40.5cm | P/F |
| 32 | Jul-71 | W of Boyup Brook | @ 4+ 315g | 42.0cm | P |
| 33 | Jul-71 | W of Boyup Brook | @ ò5+ 265g | 40.5cm | P |
| 34 | Jul-71 | Palgarup | @ >4 320g | 41.0cm | Townsite |
| 35 | Jul-71 | Palgarup | @ 3+ 260g | 38.0cm | Townsite |
| 36 | Jul-71 | Pemberton | @ 1+ 280g | 38.0cm | Townsite |
| 37 | Jul-71 | Pemberton | @ >4 265g | 41.5cm | P/F |

---

MtÿBarker-Denmark-Albany

| | | | | | |
|---|---|---|---|---|---|
| 38 | Jul-71 | SW of Mt Barker | @ >4 340g | 42.0cm | P/B |
| 39 | Jul-71 | SW of Mt Barker | @ 1+ 305g | 40.5cm | P/B |
| 40 | Jul-71 | Mt Barker | @ 1+ 295g | 42.0cm | P/B |
| 41 | Jul-71 | Albany nr Airstrip | @ 2+ 320g | 42.5cm | P |
| 42 | Jul-71 | Bornholm | @ >4 335g | 43.0cm | P |
| 43 | Jul-71 | Bornholm | @ >4 305g | 43.5cm | P/B |
| 44 | Jul-71 | Kendenup | @ >4 305g | 43.0cm | P/B |
| 45 | Jul-71 | Kendenup | @ >4 315g | 43.0cm | P/B |

---

Qualeup-Frankland-
Rocky-Gully

| | | | | | |
|---|---|---|---|---|---|
| 46 | Jul-71 | W of Cranbrook | @ 1+ 305g | 40.5cm | P |
| 47 | Jul-71 | Rocky Gully | @ 1+ 305g | 41.0cm | P |
| 48 | Jul-71 | Rocky Gully | @ 1+ 290g | 40.5cm | P |
| 49 | Jul-71 | Frankland | @ >4 300g | 42.0cm | P |
| 50 | Jul-71 | Riversdale | @ >4 285g | 41.5cm | P |
| 51 | Jul-71 | E of Mobrup | @ 2+ 315g | 40.5cm | P/B |
| 52 | Jul-71 | W of Jingalup | @ 1+ 305g | 38.0cm | P |
| 53 | Jul-71 | Narlingup | @ >4 360g | 43.5cm | P |

Mumballup-Collie-
Darkan-Duranillin

| | | | | | |
|---|---|---|---|---|---|
| 15 | Jul-71 | Glen Mervyn | @ >4 350g | 41.5cm | P |
| 14 | Jul-71 | Cardiff | @ >4 280g | 41.5cm | Forest |
| 13 | Jul-71 | Collie | @ >4 290g | 43.5cm | Townsite |
| 54 | Jul-71 | Capercup | @ 1+ 305g | 40.5cm | P |
| 55 | Jul-71 | Muja | @ >4 340g | 43.0cm | P |
| 56 | Jul-71 | Bowelling | @ 2+ 290g | 40.5cm | P |
| 57 | Jul-71 | Boolading | @ 2+ 300g | 40.5cm | P |
| 58 | Jul-71 | Darkan | @ 6+ 355g | 42.0cm | P |

Williams-Boddington

| | | | | | |
|---|---|---|---|---|---|
| 59 | Jul-71 | Williams | @ >5 310g | 41.5cm | P |
| 60 | Jul-71 | SW of Williams | @ 1+ 250g | 39.5cm | P |
| 61 | Jul-71 | Quindanning | @ ò3+ 315g | 41.0cm | P |
| 62 | Jul-71 | S of Boddington | @ 2+ 300g | 42.5cm | P/B |
| 63 | Jul-71 | SW of Boddington | @ <5 295g | 42.5cm | P/B |
| 64 | Jul-71 | SW of Boddington | @ 2+ 295g | 41.5cm | P/B |

| DDT & | Dieldrin | DDT metabs | Dieldrin |
|---|---|---|---|
| 0.01+ | | 0.01 a | a |
| | 0.03 | 0.01 0.01+ | a |
| 0.02+ | | 0.02 a | a |
| 0.02+ | <0.01 | | 0.01 <0.01 |
| No sample | | 0.03 | 0.02 |
| | 0.02 | 0.43 0.01+ | 0.11 |

| | | | |
|---|---|---|---|
| | 12 | 19 | 9.6 13 |
| | 2 | 1.7 0.4 0.3 | |
| | 3.2 | 1 0.9 0.2 | |
| | 1.2 | 1.5 0.4 0.2 | |
| No sample | 4.2 3.2 | | |
| ?33.0 | | 12 2.3 1.1 | |
| | 1.7 0.2 0.4 0.1 | | |
| | 1.7 0.2 0.3 0.03 | | |
| | 0.5 0.3 0.2 | | |
| | 3.8 | 2.2 1.2 0.3 | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.6 | 0.2 | 0.4 | 0.1 | | | | | | | | |
| 0.5 | 0.3 | 0.4 | 0.1 | | | | | | | | |
| 3.4 | | | | | | 3.4 | 0.4 | 0.5 | | | |
| 1.7 | | | | | | 1.7 | 0.4 | 0.4 | | | |
| 0.02 | 0.01 | 0.02 | <<0.01 | | | | | | | | |

---

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.61 | | | | | | 0.04 | | | 0.35 | | 0.01 |
| 1.93 | | | | | | 0.03 | | | 0.75 | | 0.01 |
| 3.6 | | | | | | 1.8 | | | 0.8 | | 0.3 |
| 6.8 | | | | | | 1.1 | | | 3.8 | | 0.6 |
| 9.8 | | | | | | 0.4 | | | 3.8 | | 0.4 |
| 0.2 | | | | | | 0.06 | | | 0.2 | | 0.03 |
| 25 | | | | | | 0.18 | | | 9 | | 0.01 |
| 1.7 | | | | | | 0.1 | | | 1.2 | | 0.02 |
| 0.5 | | | | | | 0.1 | | | 0.3 | | 0.01 |
| 8.2 | 0.05 | | 14.0 | | | | 0.1@ | | | | |

---

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.1 | | | | | | 0.4 | | | 0.04 | | 0.03 |
| 1.2 | | | | | | 0.5 | | | 0.3 | | 0.07 |
| 0.01 | 0.01 | | <0.01 | <<0.01 | | | | | | | |
| 0.03 | | | | | | 0.02 | 0.01 | <<0.01 | | | |
| 0.07 | | | | | | 0.01 | 0.03 | <<0.01 | | | |
| 0.01 | | | | | | 0.01 | | | 0.05 | <0.01 | |
| 0.2 | | | | | | 0.05 | 0.08 | 0.02 | | | |

---

0.01 <0.01 <0.01 <<0.01

0.01 0.01 <0.01 <<0.01

0.01+ <<0.01 <0.01 <<0.002

0.02 0.02 <0.01 <<0.01

0.18 0.01 0.05+ <<0.01

0.04 0.04 0.01+ a

<<0.01

<0.01 0.01 <0.01 <<0.01

0.02 0.01 0.02 0.01

0.08 0.02 0.02+ 0.01

0.32 0.02 0.08 0.01

0.04 0.01 0.01+ <0.01

0.02+ 0.01 0.01+ <0.01

0.01 <0.01 0.02 <<0.01

<0.01 <0.01 <<0.01 <<0.01

0.06 0.02 0.01 <0.01

0.06 0.03 0.02 0.01

---

0.06 0.02 0.02 <0.01

0.07 0.03 0.05 <0.01

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 0.05 | | | 0.02 | | 0.05 | | 0.02 | |
| 0.01+ | | 0.01 | <0.01 | | <0.001 | | | | |
| | 0.02 | | | 0.01 | 0.01 | <0.01 | | | |

---

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 0.41 | | | 0.22 | | 0.16 | | 0.03 | |
| | 1.8 | | | 0.6 | | 0.9 | | 0.3 | |
| | 0.19 | | | 0.1 | | 0.06 | <0.01 | | |

---

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| <0.01 | | 0.03 | <<0.01 | | | 0.01 | | | |
| | 0.16 | | | 0.3 | | 0.05 | | 0.1 | |
| | 0.28 | | | 0.08 | | 0.13 | | 0.03 | |
| | 0.03 | | | 0.1 | 0.01+ | | | 0.02 | |
| | 0.04 | | | 0.08 | | 0.03 | | 0.02 | |
| | 0.05 | | | 0.02 | | 0.03 | | 0.01 | |
| | 0.08 | | | 0.02 | | 0.04 | | 0.01 | |
| | 0.04 | | | 0.03 | | 0.04 | | 0.02 | |

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 6.82 | | | 3.1 | | 3.4 | | 1.5 | |
| | 0.03 | | | 0.01 | | 0.04 | | 0.01 | |

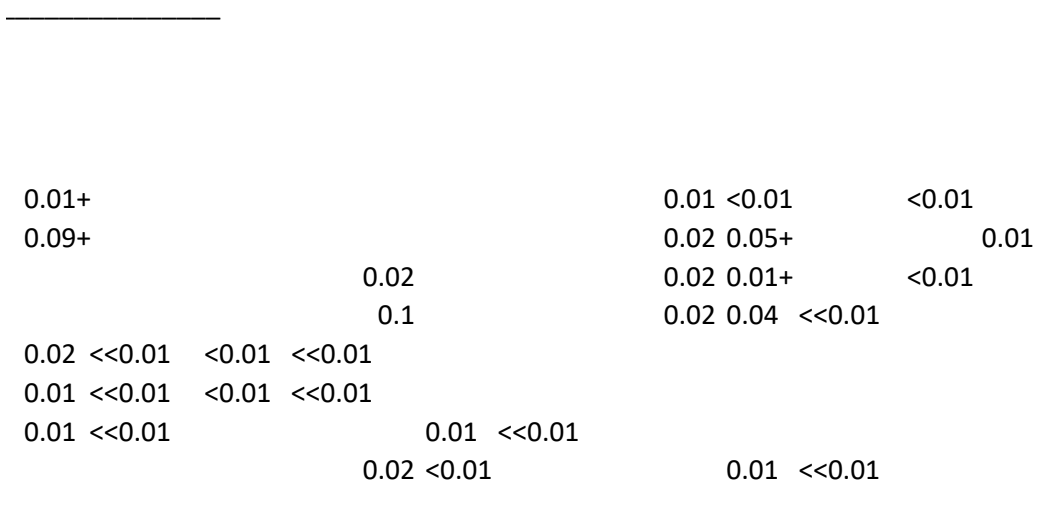
| | | | |
|---|---|---|---|
| 0.1 | 0.01 | 0.05 | 0.01 |
| 0.13 | 0.04 | 0.03 | 0.01 |
| 0.02 | 0.14 | 0.03 | 0.03 |
| 0.54 | 0.16 | 0.15 | 0.04 |
| 0.13 | 0.14 | 0.04 | 0.02 |
| 0.06 | 0.14 | 0.02 | 0.07 |
| 1.25 | 0.05 | 0.27 | 0.01 |
| 0.7 | 1 | 0.1 | 0.1 |

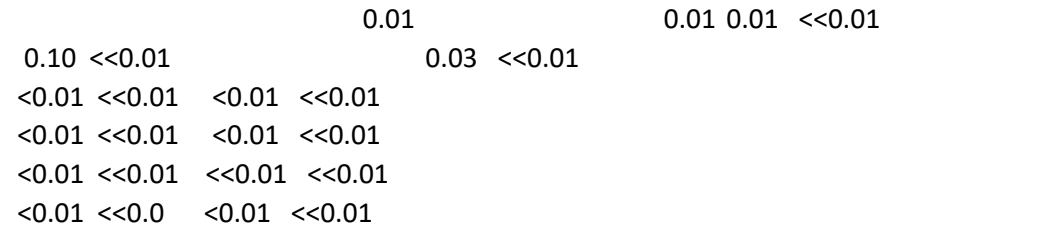
---

| | | | |
|---|---|---|---|
| 0.06 | 0.02 | 0.04 | <0.01 |
| 0.05 | 0.2 | 0.04 | 0.01 |
| 0.1 | 0.04 | 0.05 | 0.01 |
| 0.08 | 0.01 | 0.06 | 0.01 |
| 0.2 | 0.1 | 0.05 | <0.01 |
| 0.3 | 0.1 | 0.09 | <0.01 |
| 0.4 | 0.05 | 0.2 | <0.01 |
| 0.2 | 0.02 | 0.2 | <0.01 |

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| | | | |
|---|---|---|---|
| 0.06 | 0.02 | 0.1 | 0.01 |
| 0.04 | <0.01 | 0.05 | <0.01 |
| 0.04 | <0.01 | 0.06 | <0.01 |
| 0.2 | <0.01 | 0.1 | <0.01 |
| 0.04 | <0.01 | 0.02 | <0.01 |
| 0.02 | <0.01 | 0.02 | <0.01 |
| 0.1 | <0.01 | 0.04 | <0.01 |
| 0.05 | <0.01 | 0.01 | <0.01 |


0.01+
0.09+
0.02
0.1
0.02 <<0.01 <0.01 <<0.01
0.01 <<0.01 <0.01 <<0.01
0.01 <<0.01 0.01 <<0.01
0.02 <0.01 0.01 <<0.01
0.01 <0.01 <0.01
0.02 0.05+ 0.01
0.02 0.01+ <0.01
0.02 0.04 <<0.01


0.01
0.10 <<0.01 0.03 <<0.01
<0.01 <<0.01 <0.01 <<0.01
<0.01 <<0.01 <0.01 <<0.01
<0.01 <<0.01 <<0.01 <<0.01
<0.01 <<0.0 <0.01 <<0.01
0.01 0.01 <<0.01

Selected pages printed 11/6/2014

# Monitoring Pesticides - A Review

* SW Region study — page 41, 58
(Power plant)

A Report to the

Environmental Protection Authority

* One mention each on page 42

Note pages ii, 4, 31, 41, 42, 44, 58

Environmental Protection Authority
Perth, Western Australia
Bulletin 407 December 1989

# Monitoring Pesticides - A Review

A Report to the Environmental Protection Authority
by
Peter A Rutherford

Environmental Protection Authority
Perth Western Australia
Bulletin 407 December 1989

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## 1. INTRODUCTION

For centuries man has been controlling pests that compete for his food supply, endanger his health or interfere with his comfort. Until the mid-nineteenth century, pest control was effected by mechanical means, which for agriculture necessitated labour intensive operations. Since then, chemical pest control has developed into the multi-national industry it is today.

The first recorded use of a chemical pest control agent was the use of sulphur for fumigating the home in ancient Greece (about 1000 BC). Since that time arsenic has been used by the Chinese to control garden pests, and in 1649, rotenone was used to paralyze fish in South America.

Pyrethrum, lime and sulphur combination, arsenic, sulphur, mercuric chloride and soaps were all introduced in the early 1800s. These and other, largely inorganic, chemicals were in general domestic and agricultural use until 1936 when pentachlorophenol was introduced as a wood preservative (Ware, 1983).

This heralded the beginning of a pest control revolution, in which well known organic chemical pesticides, such as DDT, 2,4-D, captan, and atrazine were developed. In the early days - 1940-1960, most organic pesticides were fairly broad spectrum in their application. Recent years, however, have seen the development of complex organic chemicals which are more target-specific, and also satisfy the community's increasingly strict needs for human and environmental safety.

Pesticides are chemicals <u>designed</u> to kill pests. Because pesticides are biologically 'active', it is inevitable that some environmental effects will result from their use. Many of the environmental effects of pesticides will be minor, and these can usually be accommodated by the environment. Some effects may be beneficial. However, there is no doubt that some pesticide uses produce, either directly or indirectly, significant undesirable impacts on the environment.

In 1985 a Canadian researcher, Catherine Jefferson, who was temporarily employed by the Western Australian Department of Conservation and Environment (now EPA), reported that significant undesirable impacts by pesticides in WA may be occurring, and that monitoring systems, by various State Government agencies, then in place, would be unlikely to detect them.

As a result, the Environmental Protection Authority (EPA) has commissioned this study. The author, Peter Rutherford, is Pesticide Coordinator of the WA Department of Agriculture and was seconded to the EPA for three months, commencing in June 1987.

However, the pesticide residue crisis which hit the beef industry in mid-1987 necessitated the author's return to the Department of Agriculture in mid-July 1987, to assist with the management of the problem. He was not able to complete his secondment until November-December 1988.

The aims of the study were to:

1. Review existing use patterns of pesticides in Western Australia, identifying actual and potential environmental impacts.

2. Review past and current procedures, being conducted by State Government and other agencies, to monitor the environmental impact of pesticides.

3. Discuss the adequacy of existing programmes on an ecosystem basis, and

4. Make recommendations to the EPA regarding future monitoring needs, and any other action that should be taken to eliminate or minimise environmental impacts of pesticides.

The study was confined to:

1. Pesticides, as defined in the Health (Pesticides) Regulations of the Health Act, viz:

   "a substance or compound used or intended for use for agricultural, pastoral, horticultural, domestic, or industrial purposes for controlling, destroying, or preventing the growth and development of, any fungus, virus, insect, mite, mollusc, nematode, plant or animal and includes all preparations and admixtures containing any proportion of any one or more of them;"

   This definition excludes veterinary drugs and fertilisers.

2. The natural and physical environment, including water, soil, air and all natural animals and plants that are part of the environment. The effects of pesticides on man, domestic animals, agricultural crops and any residues in agricultural produce were excluded from the study.

Summary of recent events

The 'beef residue crisis' previously referred to, forced governments, the agricultural industry, and the community at large, to make adjustments to their use of certain pesticides, and to their perception of pesticide use generally. These changes have implications for the direction of this report, so it is relevant to provide the following summary of events and outcomes.

. The US Department of Agriculture detected three high DDT residues in one consignment of beef imported from Australia.

  This discovery, together with some later violative residues of DDT and dieldrin which were found, threatened the $750 million beef export industry to the USA.

. Commonwealth and State governments, and industry, reacted quickly by setting up residue detection screening at all export, and many domestic, abattoirs. This resulted in many beef properties having restrictions placed on their beef cattle sales and movements. This is ongoing in all States.

. State governments completely banned all remaining uses of DDT, and removed all registered agricultural uses for dieldrin, heptachlor and chlordane.

  In WA, DDT was deregistered on 27 July 1987, and the other organochlorines were restricted to the control of termites in the building industry, and in the case of heptachlor, also for Argentine Ant, and Singapore Ant control, in September 1987. The availability of these chemicals was also limited to licensed pest control operators.

In February 1988, the State Government temporarily suspended the use of heptachlor for Argentine Ant control because of public concerns over human health and environmental contamination. The EPA was requested to review the use of heptachlor for the control of Argentine ants and subsequently released a discussion paper (EPA Bulletin 325) which sought public comment.

The review was later extended to include the use of heptachlor for termite control. The EPA published its report to the Minister for Environment, after considering public submissions, as Bulletin 354, in October 1988. The main thrust of this report was that Heptachlor should not continue to be registered for Argentine Ant control, but that its registration as a termiticide should remain. The State Government agreed to this recommendation and the Commissioner for Health, acting on the advice of the Pesticides Advisory Committee, removed the registration of heptachlor for Argentine Ant control in late 1988.

The outcome of these events is that the only registered use for Heptachlor, chlordane, aldrin and dieldrin are as termiticides in the building industry. In addition these events have considerably increased public awareness of the uses of pesticides in the production of food, and in the control of urban pests. This increases the need for Government agencies to be more accountable regarding pesticide uses, and to be more aware of public health and environmental impacts.

## 2. RECOMMENDATIONS

1. The Government should give consideration to expanding the scope of the Dangerous Goods (Road Transport) Regulations 1983 to include those additional pesticides which are deemed by the Environmental Protection Authority to be of environmental concern.

2. The Recommendations of the Stored Chemicals Sub-Committee, presented in its final report of February 1986, should be implemented as soon as possible.

3. The Department of Agriculture should carry out an extension programme on the safe storage of pesticides on farms and other private property.

4. The Health Department, in conjunction with the Department of Agriculture and the Environmental Protection Authority, should draw up guidelines for the disposal of pesticide containers on farms, and on Local Authority tipsites. These will complement amendments to the Health (Pesticides) Regulations which came into effect on 1 January 1989.

5. The Government should investigate ways of encouraging the use of pesticide drum-crushing contractors as a means of disposing of unwanted used containers.

6. The Roadside Conservation Committee should continue to investigate reports of herbicide damage to native vegetation, and if necessary, recommend ways of minimising the problem.

7. The Department of Conservation and Land Management should re-introduce a monitoring programme for pesticide residues in the Australian Magpie (Gymnorhina tibicen).

8. The Agriculture Protection Board, in conjunction with the Department of Agriculture, should investigate the possibility of using the European Wild Rabbit (Oryctolagus Cuniculus) as a means of monitoring organochlorine (and other) pesticide residues in WA land and vegetation.

9. The Water Authority of Western Australia should extend its pesticide residue monitoring programme to include all major river systems which drain agricultural land.

10. The Environmental Protection Authority and Waterways Commission should continue to monitor pesticide residue levels in water, sediments and indicator organisms in estuaries.

11. A research project into the levels of pesticides found in rainfall over the coastal plain should be carried out by an appropriate body, such as the Chemistry Centre of WA, Murdoch University or CSIRO.

12. The Health Department should extend the analysis of water samples, taken from permanent bores at rubbish tips, to include pesticide residues, particularly the organochlorine insecticides.

13. The Department of Conservation and Land Management, as the manager of Western Australia's fauna, in conjunction with other managers of wetlands, should monitor wetlands for pesticide residues, and their effects on wetland ecology.

14. The Department of Marine and Harbours should extend their harbour water sampling programme to include sediments, and analysis for pesticide residues.

15. A Coordinating Committee for Environmental Monitoring of Pesticides should be established and serviced by the Department of Agriculture. It may be appropriate for the Committee to report to the WA Advisory Committee on Hazardous Substances (WAACHS).

16. The Department of Agriculture should increase its commitment of financial and human resources for the adequate monitoring of pesticides and the effects in the rural environment.

All pesticides used in the garden for plant protection are derived from agricultural use by reformulation into dilute mixtures and repacking into small packs.

Of the organochlorines, chlordane was available in a 500 ml pack until mid 1987, and was used as a termiticide for "small" infestations, such as wooden fence-posts, woodheaps and pergola posts.

Actual and Potential Environmental Impacts

These chemicals are likely to make some contribution to ground water contamination in Perth.

4.5.6 ARGENTINE ANT CONTROL

Description and Location

Until November 1988 control of Argentine Ants was the responsibility of the Agricultural Protection Board, acting under the powers given by the Argentine Ant Act 1968.

The circumstances surrounding the State Government's decision to abandon Argentine Ant control activities are explained in the Introduction to this report. However, a summary of the programme as implemented over the last several years is provided as background information to any environmental impacts.

Argentine Ant control took place in the summer months, from October to April as the ants are most active in the warmer weather. It involved the detection of ant trails and laying down a chemical 'grid' over the area infested.

Since the late 1940s - early 1950s when the programme started, dieldrin was used exclusively, however in the early 1970s this was replaced by heptachlor. In agricultural areas, where the use of heptachlor may have led to undesirable residues in livestock products, chlorpyrifos was used with reasonable success after 1985.

Argentine ants have been found in many areas of the South West of the State, particularly in the higher rainfall areas. Thus significant infestations have been treated at Esperance, Albany, Bunbury, Busselton and in Perth. Smaller infestations in many wheatbelt centres have also been treated in the past.

The majority of infestation which remain untreated are in the Perth metropolitan area. They are centred around the shores, and adjacent suburbs, of the chain of freshwater lakes north of Perth. The Herdsman's Lake infestation is the largest of these infestations.

Method of application

In most situations, dilute (0.5%) heptachlor emulsion was applied in a grid pattern across the infested area using a hand-held, low pressure sprayer, applying a band a few centimetres wide.

In some instances, blanket spraying has been necessary over a limited area.

Environmental Impacts

1. Contamination of groundwater and wetlands. The use of dieldrin, and latterly heptachlor, for Argentine Ant control has, like pest control operations, contributed to organochlorine residues being found in groundwater and wetlands.

2. The external application of heptachlor (or any organochlorine) on the soil surface has the potential to affect non-target animals.

3. Death of aquatic species. Use of heptachlor around Perth's wetlands has caused significant but transitory reductions in aquatic invertebrate numbers (Davis and Garland 1986).

4.5.7 MOSQUITO/MIDGE CONTROL

Description and Location

The control of mosquito and midge insects in wetlands that border urban development largely involves the application of temephos granules to the waterbody during the summer. This insecticide is used as a larvaecide to reduce the 'flush' of insects that emerge as biting and nuisance adults during the summer.

In addition, insecticides such as malathion (maldison) and, to a lesser extent, bioresmethrin are used to fog areas between homes and the wetland, as well as the wetland itself, to directly control adult swarms of these insects.

These activities are under the control of Local Government, however, officers of the Health Department and CALM provide advice on request. The extent to which these treatments are carried out each year depends on the wetland in question, the season, the number of complaints received by the Council, and cost.

Most pesticide use on wetlands for insect control occurs in the Perth metropolitan area. At least a dozen lakes and wetland areas in and around Perth are regularly treated. In country areas, temephos and malathion are used in the Leschenault and Peel estuaries and in the Kimberleys, particularly at Broome and Derby.

Application methods vary from aerial spreading of temephos granules to fogging applicators for malathion.

Actual and Potential Environmental Impacts

1. Bird deaths. Temephos is moderately to highly toxic to birds, and is formulated as a granule which can easily be picked up by a ground or shallow water feeding bird. Hundreds of Red Stints died at Lake Forrestdale in 1984 as a result of temephos granules applied to the rapidly drying lake.

2. Alteration of the ecology of the wetland. There is evidence that each treatment affects the ecological balance of the wetland by killing non-target species of invertebrates.

While no results have been published, the study has provided much information on the degradation rates of these chemicals in the metropolitan environment. The results show that the initially high levels of heptachlor and chlordane in herbage fall to less than 1 mg/kg within 12 months of application, but that residues after that time decline extremely slowly, and are likely to be detectable for some years to come.

4. DDT levels in soil, crop and pasture, water and sediment, as a result of its use in cereal cropping (unpublished report)

Mr C Sharpe, Pesticide Advisor, conducted a monitoring study from December 1983 to May 1985 to assess the levels of DDT found in agricultural soils, in crops and pastures growing in those soils, in water draining from the soils and thence to a permanent lake and the Avon River, and in sediments at the bottom of the water bodies.

The report was prepared for the Pesticides Advisory Committee. The results of the study are summarised as follows:

- The soil DDT levels showed a rapid rise after spraying. They then fell over a 2-week period after which there was little or no DDT loss. This provides a new 'base' for a future DDT application.

- Pasture levels of DDT, even one year after spraying in the crop, still exceeded the Maximum Residue Limit for DDT in animal feeds (0.05 mg/kg). Crop residues were lower, but could contribute to a grazing animal's body burden.

- DDT levels in the water and sediments fluctuated with the times of peak flow in winter. The water levels frequently exceeded the EPA criteria.

This study appears to be the only one which has attempted to monitor the effects of a persistent insecticide in the wheatbelt. It is of particular value in that regard.

5. Insecticide residues in agricultural soils (unpublished data)

In mid-1987, the beef industry was faced with the problem of excessive residues of organochlorine insecticides in beef exported to the USA. Massive industry and government resources were committed to solve the problem by:

- detecting violative animals at the point of slaughter, and if possible, on the farm.

- detecting and removing the source of contamination on individual properties.

This latter activity involved the taking of thousands of soil samples, by officers of the WA Department of Agriculture, from properties designated "at risk" by virtue of their agricultural history, or whether violative animals from the property had been detected at abattoir.

The results of the analysis of the samples are presented in Table 6:

Table 6. Levels of organochlorine insecticides found in some agricultural soils of the south west of WA.

| CONCENTRATION (mg/kg) | NO. OF DETECTIONS (% of 11,248 SAMPLES) CHLORDANE | DDT | DIELDRIN | HEPTACHLOR |
|---|---|---|---|---|
| 0 - 0.09 | 858 (7.6) | 1080 (9.6) | 1521 (13.5) | 924 (8.2) |
| 0.1 - 0.49 | 1007 (9.0) | 1575 (14.0) | 1860 (16.5) | 934 (8.3) |
| 0.5 - 0.99 | 162 (1.4) | 780 (6.9) | 610 ( 5.4) | 190 (1.7) |
| > 1.0 | 50 (0.4) | 1023 (9.1) | 407 ( 3.6) | 73 (0.6) |
| TOTAL DETECTIONS | 2077 (18.4) | 4458 (39.6) | 4398 (39.0) | 2121 (18.8) |

In this Table, all samples were analysed for all four organochlorines, however, not all samples contained all of these insecticides.

It must also be remembered that these samples were taken from selected properties where residue levels were expected. These results are not representative of soil residue levels of the South West generally.

These results also exclude samples from experimental plots and from "hot spots", for example, near State Energy Commission power poles.

6. Miscellaneous monitoring work

The Department of Agriculture, over many years, has taken many hundreds of samples of soils, vegetation and water for analysis for pesticide residues. Many of these samples have been taken for health or agricultural reasons, but collectively they provide a body of knowledge about how pesticides act in the physical environment.

For example:

- 19 samples of ground water were taken from Burswood Island in 1986, by the Entomology Branch, to assess the effects of Argentine Ant treatments. All samples were found to contain <0.01 $\mu$g/L of any organochlorine except one sample containing 0.09 $\mu$g/L of heptachlor.

- Samples of water from farm dams, house rain-water tanks, and town water supply dams in the eastern wheatbelt in 1984 and 1985 were taken as a result of publicity about possible effects of herbicide spraying in the area. No detectable residues of diuron, 2,4-D, chlorsulphuron, trifluralin, triallate, paraquat, diquat or glyphosate were found.

In addition to these small residue analyses, the Department has carried out many trials with both new, and already registered, pesticides, in new situations. While a discussion of this work is outside the scope of this study, much supplementary knowledge of the likely environmental effects of using these chemicals is being amassed.

### 5.2.2 AGRICULTURE PROTECTION BOARD

The Agriculture Protection Board (APB) is the government agency which is empowered, under the Agriculture and Related Resources Protection Act 1976, to control those weeds and vermin which are actual or potential threats to agriculture. It is a major user of pesticides, mainly herbicides, and its activities are examined in detail in Chapter 4.

Research on the control of "declared animals" is carried out by the Research Branch of the APB based at Forrestfield. Research into the control of "declared plants" is the responsibility of the Weed Science Branch of the Department of Agriculture, although funding is provided by the APB.

Because they are introduced, many declared plants, and declared animals are as much a threat to the natural environment as they are to agriculture. Control measures, particularly those in non-agricultural situations are therefore implemented with consideration for the environment.

#### Declared Plants

Only one environmental monitoring project has been carried out with respect to Declared plant control.

1. Herbicide residues in flowing streams (unpublished report)

A large proportion of Blackberry infestations occur very close to streams or waterbodies. Therefore, herbicide control measures have the potential to contaminate the water body, at the time of spraying, and soon after. This project was designed to measure the potential of glyphosate, triclopyr and picloram herbicides to contaminate the Brunswick River after a simulated Blackberry spraying operation.

Samples of water and sediment were taken at the site of application and 20 m downstream at 1 minute intervals to 5 minutes after spraying, then 20, 60 and 120 minutes after, and 1 week later.

Analysis of the samples showed that no detectable glyphosate or picloram residues were present in either the water or sediment, and that triclopyr was not found in the sediment. Triclopyr residues were found in the water, 1 minute after spraying and 20 m downstream at a maximum level of 0.6 $\mu$g/L. These levels declined to <0.02 $\mu$g/L (Limit of Detection) after sixty minutes.

#### Declared Animals

1. Non-Target Fauna - effect of dingo baiting (King, 1988)

   For many years, the APB has conducted research into the toxicity of sodium fluoroacetate (1080), used in both rabbit and dingo baits, to a number of native animals. This work has largely involved laboratory studies with various species to determine their respective $LD_{50}$ for 1080. The work has found that many local native species of birds, reptiles and mammals are naturally more tolerant to 1080 than their counterparts from other States. This is due to their exposure over the centuries to species of Oxylobium and Gastrolobium plants which contain naturally high levels of 1080.

An extension to this work has just been completed. A field study was conducted to determine the actual hazard posed to the Northern Quoll (Dasyurus hallucatus) by aerial baiting with 1080 dingo baits. This species had been identified in laboratory studies as being the species in the pastoral areas which was most at risk from baiting programmes for dingo control.

The study concluded that as all 10 animals originally trapped, fitted with radio collars and released, had survived the baiting, then any other native species of even lower risk should also survive the baiting operation.

2. Fenitrothion levels in the environment after locust spraying campaign, 1982 (unpublished report)

From October to December 1982, the Agriculture Protection Board applied or supplied to farmers for their own application 26 000 kg of technical fenitrothion and 26 000 kg of formulated fenitrothion for the control of a major outbreak of the Australian Plague Locust. The infestation occurred in the Great Southern and South Eastern Wheatbelt, and a total of about 117 000 hectares were sprayed (41 000 hectares by air).

Mr C Sharpe, Pesticide Adviser, collected 31 samples of vegetation, water, soil and locusts during the campaign. These were analysed for fenitrothion residues. Residues were found in 3 water, 7 vegetation, 6 soil and 3 locust samples. The highest levels found were 0.7 $\mu$g/L in water, 37.0 mg/kg in pasture herbage, 3.8 mg/kg in soil, and 9.6 mg/kg in locust samples.

The study report suggested that the fenitrothion spraying had no effect on agriculture, but was not sufficiently detailed to assist in an assessment of environmental effects. However, freshwater marron living in dams, and birds feeding on locust carcases, may be affected by the fenitrothion levels in water and locusts respectively.

### 5.2.3 CONSERVATION AND LAND MANAGEMENT

The Department of Conservation and Land Management (CALM) is a large organisation which covers three main activities, Forest Management and Production, National Park Management, and Wildlife Management and Research.

As the manager of large areas of national parks, State forest, and soft wood plantations, CALM is a significant user of pesticides (mostly herbicides) as described in Chapter 3. However, no environmental monitoring studies of CALM's pesticide use has been attempted.

CALM is also host to an advisory body, the Roadside Vegetation Conservation Committee (RVCC) - The aims of the Committee are

"to coordinate and promote the conservation and effective management of rail and roadside vegetation for the benefit of the environment and the people of Western Australia".

The RVCC is embarking on a number of research projects, to be coordinated by its executive officer, Ms Penny Hussey. One of these projects was to investigate the effects of pesticide application, both by rights-of-way managers, and adjoining farmers, on native vegetation in road and rail reserves. A draft report prepared by Murdoch University in November 1988 is before the RVCC, awaiting comments.

CALM's Wildlife Research Centre, has conducted three major monitoring projects on the effects of pesticide residues on birds.

1. Organochlorine Residues in the Western or Australian Magpie (unpublished report)

A total of 114 Australian Magpies were collected between December 1970 and April 1973. The majority of the birds (70) were collected within the Perth-Albany-Cape Naturaliste triangle during mid 1971. The other 44 birds were obtained from a variety of sources, including the Perth Metropolitan Area, Pinjarra, Mingenew and other agricultural areas.

The bird samples were, when possible, dissected in the field at collection, and the liver and pectoral muscles forwarded for analysis. In some cases, the whole bird was frozen and submitted for dissection in the laboratory.

The results of this study, conducted by Dr R Prince, have not been analysed in detail, but it appears that:

- only DDT and dieldrin residue levels are reported;
- there is little difference between residue levels in the liver and the pectoral muscle;
- the residue levels are very variable, but birds from the Perth Metropolitan area, and the eastern hills orchards and forest areas contain the highest residue levels. Maximum levels found in these areas were 33 mg/kg of DDT (liver) and 12 mg/kg dieldrin (liver). In agricultural areas, the levels found were almost all less than 1 mg/kg, with many as low as 0.01 mg/kg of either DDT or dieldrin.

The Australian Magpie was selected as an indicator species because it is widespread and numerous throughout the south west, largely insectivorous, long-lived, sedentary and territorial. This makes it an ideal species for an assessment of pesticide contamination of the terrestrial environment.

2. Pesticide levels after Plague Locust spraying operations - (unpublished data)

In 1971, the Agriculture Protection Board was involved in spraying agricultural land near Mingenew with malathion for Plague Locust control. Officers from the Wildlife Research Centre took a total of 57 bird samples from an area not treated with maldison, and 53 bird samples from a treated area. Samples of both live and dead locusts were also taken from the treated area.

The analysis of these samples showed that no malathion was detected in any bird tissue, even after treatment. Malathion residues were detected in live (0.4 mg/kg) and dead locusts (1mg/kg).

The birds were also found to contain DDT, Dieldrin and Hexachlorobenzene in many tissues (mainly liver) at levels around 0.01 mg/kg for each chemical with occasional samples containing up to 0.6 mg/kg of one of the pesticides.

3. Miscellaneous residue levels in birds

Several samples of different species of birds, and eggs, from a wide range of localities were collected and analysed during the early to mid 1970s. Samples ranged from Ospreys at Shark Bay to Owls at Mandurah. Almost all samples contained low levels of organochlorine insecticides, up to a maximum of 60 mg/kg of DDT in an Owl from Lake Argyle and 14 mg/kg of dieldrin in a Mudlark from Karratha (this sample taken in 1983).

## 5.2.4 ENVIRONMENTAL PROTECTION AUTHORITY

One of the primary functions of the Environmental Protection Authority (EPA) is "to ensure that environmental quality is maintained" (1985/86 Annual Report). It carries out this function by coordinating the efforts of other organisations and agencies that are directly responsible for the management of various parts of the environment.

This has been the case for the following pesticide monitoring studies coordinated by the EPA. Much of the work has been conducted by other organisations, for example, Murdoch University, as part of a study group established by the EPA to examine a specific problem.

1. Pesticide Residue Level in Cockburn Sound (Chegwidden 1979)

A number of specific studies were carried out in the mid-1970s, leading to the production of the Cockburn Sound Environmental Study, 1976-1979 published by the then Department of Conservation and Environment (Report No 2). One of these studies investigated the presence of pesticide residues in water, sediment and mussels of several localities in Cockburn Sound.

Levels of total organochlorine insecticides found in the sediments and mussels of Cockburn Sound were less than 0.001 µg/kg. Sediments from one sampling station in Owen Anchorage contained 4 µg/kg of dieldrin while the effluent from Anchorage Butchers contained 15 µg/kg of dichlorvos insecticide. No pesticide residues (in fact, no chlorinated hydrocarbons of any sort) were found in samples of the common mussel Mytilus edulis taken from the Sound. The study concluded that the extent of pesticide contamination could not be inferred from one sample, and recommended that "a survey be taken to quantify the extent of sediment and biota contamination by pesticides, particularly in Owen Anchorage".

2. Study to establish baseline levels of contaminants and nutrients in marine waters of WA (Chegwidden 1981)

This study was conducted as part of the marine quality assessment programme (Map 15) in 1980/81. The site chosen for the study was the CSIRO Rottnest Island 50 m station. This was in 50 m of water, 3.3 km due west of Cape Vlaming, Rottnest Island.

Water samples were taken at this site on 11 occasions between April 1980 and January 1981, from the surface and at depths of 1.5 and 20 m. 10 percent of the 120 samples gave positive results for dieldrin and DDT plus metabolites. The highest levels found were 0.027 µg/L for dieldrin and 0.01 µg/L for DDT and metabolites. The analytical limit of detection was 0.001 µg/L for both pesticides. Most levels detected just exceeded that limit.

The author concluded that organochlorine pesticides were present in the waters off Rottnest Island.

3. Preliminary study of pesticide residues in rivers and estuaries of WA - (unpublished report)

Water and sediment samples were collected over two sampling periods from several estuaries and their associated rivers in mid-1987. The samples were analysed for all organochlorine and organophosphate insecticides and selected herbicides.

The sediments did not contain detectable quantities of pesticides, with the exception of the Denmark River containing 0.1 mg/kg chlordane and the Sleeman River which contained 0.04 mg/kg dieldrin. Unfortunately, the limit of detection in sediments (0.01 mg/kg) was four orders of magnitude higher than the limit in water (0.001 µg/L).

In the estuarine and river waters, no herbicides or organophosphorus residues were detected. Organochlorine residues were found in all samples. Levels which exceeded the EPA criteria predominated at the first sampling time (after the first river flows for the season). The highest level of each chemical found is shown in Table 7, with the source of the sample.

Table 7. Highest levels of OC Pesticides found in SW rivers sources.

| PESTICIDE | LEVEL µg/L | SOURCE |
|---|---|---|
| DDT | 0.026 | mouth, Blackwood River |
| heptachlor | 0.007 | upper Blackwood River |
| chlordane | 0.021 | " " " |
| dieldrin | 0.009 | mouth, Denmark River |

On the basis of the number of samples which exceeded the EPA criteria for at least one of the above pesticides, the most contaminated river systems were the Blackwood, Denmark, and Hay. The Harvey, Carbunup, Sleeman, Austin, Serpentine, King, Robinson and Scott were much less contaminated. No samples exceeding the EPA criteria were found in the Murray and Kalgan river systems.

### 5.2.5 FISHERIES DEPARTMENT

The mission of the Fisheries Department is "to manage the fish resources of Western Australia for the benefit of the community" (1986/87 Annual Report). In order to achieve their objectives, the Department must, amongst other things:

- develop the aquaculture industry, and under-developed fisheries; and
- conserve fish habitats and fish species.

Studies into pollution and the environment as they affect marine fisheries and aquaculture projects are carried out by research officers of the Department. For example, research into heavy metal pollution in estuarine and marine waters are major projects.

Two projects involving pesticides monitoring, one past and one current, are attributable to the Fisheries Department. The first one, on pesticide residues in fish from the Ord River Irrigation Area, was completed in 1978. It was part of a collaborative project of the then Department of Fisheries and Wildlife, the then Public Works Department, the Department of Agriculture and the then Government Chemical Laboratories. This latter organisation prepared a report on the whole project, which is further described under the Chemistry Centre of WA.

1. Pesticides in Marron

This is a new project to be undertaken in 1989. It involves the sampling of marron, water, sediment and feeds (where applicable) from three rivers, six marron farms and the Pemberton Hatchery.

The samples will be analysed for organochlorine and organophosphorus insecticides.

The project also involves the laboratory study of low (sub-lethal) levels of organochlorines in feed on the growth, development and reproduction of marron.

2. Miscellaneous pesticide monitoring

The Fisheries Department continues to conduct 'ad-hoc' sampling of fish species for pesticide residues. These are usually in response to specific requests. For example, five species of fish (24 specimens) were sampled in Wilson's Inlet near Denmark in 1988. Unexpected residues of chlorpyrifos were found in 11 of the samples ranging from 0.01 mg/kg (the limit of detection) to 0.18 mg/kg.

5.2.6 CHEMISTRY CENTRE OF WA

The Chemistry Centre (formerly the Government Chemical Laboratories) is part of the Mines Department and provides professional chemical and analytical services to the State Government.

The Centre consists of a number of Laboratories, which specialise in different areas of chemical analysis, such as mineralogy, and forensic chemistry. The Environmental Chemistry Laboratory, and in particular, the Pesticides Laboratory have been responsible for assisting State Government Departments in the analysis of samples from pesticide monitoring projects. They also provide expert advice on the chemical feasibility of projects, correct sampling procedures, and the interpretation of results. This advice should be sought at the planning stage of any project involving the pesticide analysis of samples.

Thus the Chemistry Centre has been heavily involved in most of the projects reported in this review. The Centre has also published two significant reports on work they have carried out on their own and others behalf.

1. Report on Pesticide Residue Sampling for the Ord River Irrigation Area 1964-1978 (Gorman 1979)

This report was prepared for the Ord River Ecology Sub-Committee, and consists of a collation of results of several ad hoc monitoring exercises conducted by several departments, notably the WA Departments of Agriculture, Fisheries and Wildlife, and Public Works.

It covers the analysis of water, silt (sediments), soils, foods, pastures, stockfeeds, cattle, birdlife and fish for organochlorine and organophosphorus residues arising out of their widespread use for cotton production. Cotton production stopped in 1974 when insect pest resistance to the insecticides used became insurmountable. With the demise of cotton, the use of organochlorines fell dramatically. Their use in the Ord River Irrigation Area was so high, however, that residues in the environment continued long past 1974, and are still detectable today, albeit at much reduced levels.

2. Dieldrin Residues - A Western Australian Study (Shewchuk 1981)

This report is a compilation of all residue analyses of dieldrin in a wide range of substrates from the mid 1960s on. It covers the dieldrin levels in foods, the environment and such things as cigarettes. A useful summary of the history of dieldrin in Western Australia is provided, together with a description of its manufacture, properties and toxicology.

5.2.7 WATER AUTHORITY OF WA

The Water Authority of WA (WAWA) "plans and manages water services and water resources throughout Western Australia for the continuing benefit of the community" (Annual Report 1986).

An important component of this role is the commitment to ensure that the consumer is supplied with potable water of the best possible quality. To ensure that potable water, whether it be from surface or groundwater sources, is not contaminated with pesticides and other chemical contaminants, water monitoring programmes have been implemented.

1. Catchment Studies

Specific catchments are sampled fortnightly to monthly for up to twelve months. The water samples are analysed for a range of organic contaminants, including the organochlorine and some organophosphorus pesticides. Current catchment studies which are due for completion in early 1989 are the lower Helena, Logue Brook and Waroona catchments.

The levels found are well below the Maximum Residue Limits for the various chemicals in potable water, but many of them exceed, sometimes markedly, respective EPA criteria.

2. Reservoir monitoring

The major supply Reservoirs for the Metropolitan area are sampled and analysed for organic contaminants, including pesticides, on a yearly or twice yearly basis. The levels of pesticides found in the 1988 sampling are all below the EPA criteria, and are well below the MRLs for potable water.

3. Monitoring groundwater production bores

Sampling and analysis for a wide range of chemical and microbiological contaminants is conducted annually for all groundwater production bores. Since 1974, 130 bores have been found to contain well below the respective MRLs for potable water. However, a significant proportion of

the samples have been found to contain pesticides at levels in excess of the EPA criteria. These elevated levels are predominantly from samples taken in the last few years, as shown in the Table 8.

Table 8. Number of samples of water taken from groundwater production bores, since 1974, that exceed the EPA criteria.

| YEAR | (a) | (b) |
|---|---|---|
| 1974 | 3 | - |
| 75 | 10 | - |
| 76 | 24 | - |
| 77 | 31 | - |
| 78 | 26 | - |
| 80 | 19 | - |
| 81 | 2 | - |
| 82 | 18 | 3 |
| 83 | 31 | 3 |
| 84 | 34 | 3 |
| 85 | 41 | 13 |
| 86 | 59 | 8 |
| 87 | 47 | 28 |
| 88 | 39 | 21 |

(a) No of water samples taken in that year.
(b) No of samples containing one or more organochlorine pesticide levels in excess of the EPA criteria.

Many of the numbers shown in column (b) contain more than one pesticide level in excess of the EPA criteria. For example, in the 1987 sampling, a total of 42 individual pesticide levels exceeded the EPA criteria.

These levels are not of concern with respect to the quality of the water for human consumption (the highest level found was 0.011 µg/L). However, they are useful as indicators of the possible increasing contamination of Metropolitan groundwater from organochlorine insecticides. DDT and dieldrin provide most excessive levels with 45 and 34 respectively; only 8 heptachlor and 3 chlordane levels exceed the EPA criteria. As Perth's groundwater is recharged by direct infiltration of rainfall over the coastal plain (Ventriss 1988), these pesticide levels are likely to have originated from their previous agricultural and urban use, and to a much lesser extent, from the rainfall itself.

4. Monitoring WA Rivers and Basins

Since about 1980 WAWA has intermittently sampled four river basins - the Warren, Preston, Collie and Swan Coastal - for pesticide residues. These samples have been taken either at permanent stream gauging stations, or at other marked points along the river.

The analysis of these samples has shown the consistent presence of dieldrin and DDT residues (except in the Collie River where no residues were found). Some heptachlor levels were also found; one extreme level of 0.170 µg/L was detected in Lefroy Brook (a tributary of the Warren River, near Pemberton) in December 1981. A significant proportion of the DDT and dieldrin residues exceeded the EPA criteria. The highest dieldrin level found was 0.019 µg/L - also from Lefroy Brook in June 1982.

5. Monitoring Waste Disposal Sites

Only one sample of water has been taken from a waste disposal site for analysis for pesticide residues. In February 1979, a sample of water from the Gnangara Liquid Waste site was found to contain DDT at 0.030 µg/L.

6. Groundwater monitoring at CIK (Kwinana) Pty Ltd

In the late 1970s, routine sampling and analysis of water from shallow aquifers in the BP (Australia) Ltd site at Kwinana found elevated levels of 24-D and 245-T herbicide. Further sampling of the area found some extremely high levels of these herbicides in ground water, particularly from the pesticide manufacturer CIK (Kwinana) Pty Ltd. This company operated on a site adjacent to BP on the east.

Investigation showed that a considerable area of shallow (20 m) groundwater was contaminated with these chemicals to varying degrees. Some of the levels were well over the MRLs for potable water. The source of the contamination was the pond into which CIK (Kwinana) discharged its manufacturing and formulation wastes.

It was eventually decided that CIK (Kwinana) should dispose of its wastes by injection into a deep bore, in excess of 1 000 - 1 200 m. This was done, but not until 1986, and by then the company had been taken over by Nufarm Ltd.

Routine monitoring of all the bores in the area has been taking place over the last ten years, and is continuing, with samples to be taken at 3 monthly intervals.

7. District monitoring projects

Several WAWA districts carry out water system monitoring projects within their areas of responsibility. These projects are shown in Table 9 and are aimed at maintaining the quality of the water source for potable uses, and include analysis for pesticide residues.

Table 9. WAWA District Water Monitoring Projects

| DISTRICT | WATER SYSTEM | SAMPLING |
|---|---|---|
| COLLIE | Preston River Irrig. scheme<br>Lefroy River (Pemberton) | Monthly during Irrig. season (Nov-May)<br>Twice annual (Dec + May (or when run-off starts |
| KUNUNURRA | Ord River | Twice annually along river and drainage outlets |
| ALBANY | Scotsdale Creek (Denmark) | Fortnightly during flow period |
| MANDURAH | Dwellingup Water Supply | Three times per year |
| NORTHAM | Mundaring Catchment | Occasionally - after CALM spraying operation |
| CARNARVON | Town Water Supply | Occasionally - by Health Department |

8. Pesticide levels in soil in south west

During late 1987, when the beef cattle industry was grappling with the problem of organochlorine pesticide residues, the Water Authority assessed all its sites where organochlorine had been applied, and which could possibly be accessed by grazing animals.

A number of sites were sampled adjacent to wooden bridge structures and pumping facilities which have been previously treated for termites. All these sites were grazed by cattle, albeit intermittently in most cases.

The samples were shown to contain dieldrin at rates ranging from less than 0.01 mg/kg to 98 mg/kg. Those sites containing dieldrin at 0.1 mg/kg or greater were immediately fenced from stock access.

Some of the sites sampled were along the banks of irrigation channels. These, plus the bridge structure sites may be the source of some environmental contamination.

5.2.8 WATERWAYS COMMISSION

The Waterways Commission was established in 1976 to administer the Waterways Conservation Act 1976, and to oversee the activities of three Management Authorities (Swan River, Peel Inlet and Leschenault Inlet) established under the Act.

Section 23 of the Act outlines the duties of the Commission, which amongst other things includes:

- to preserve and enhance the quality of the environment and amenities of the waters and of the associated land to which the powers of the Commission apply, and;

- to provide advice and disseminate knowledge on the conservation and good management of river, inlets, and estuaries and of associated land.

In their pursuit of these objectives, the Commission has initiated a number of monitoring surveys involving pesticide residues (amongst other things) in rivers under their control.

1. Heavy metals in sediments and mussels of the Swan River system - (Chegwidden 1980)

2. Heavy metals and pesticides in surface sediments near slipping facilities on the Swan River - (Chegwidden 1981)

These two studies were aimed at determining the extent of environmental contamination of the Swan River by mainly heavy metals and, to a lesser extent, organochlorine pesticides.

The first study concentrated on selected drain sites in the Swan, and the second study, slipping facilities, with the aim of gauging the impact of anti-fouling paints on the riverine environment.

The new legislation will cover a gap in the State's legislative control of pesticide usage.

The Roadside Conservation Committee has, amongst others, the objective of preserving native vegetation, particularly on roadsides. It would be an appropriate function for this Committee to maintain a watching brief over the problem.

RECOMMENDATION 6

**The Roadside Conservation Committee should continue to investigate reports of herbicide damage to native vegetation, and if necessary, recommend ways of minimising the problem.**

Animals (including birds) living on land are difficult to monitor for the purpose of determining pesticide residue levels. However, two species, the rabbit, and the Australian Magpie are so widespread throughout the agricultural areas, that they appear to make ideal indicator species for monitoring the levels of organochlorine insecticides (and DDT in particular) in WA.

The magpie has been successfully used for monitoring purposes (Prince 1970-73).

RECOMMENDATION 7

**The Department of Conservation and Land Management should re-introduce a monitoring programme for pesticide residues in the Australian Magpie (Gymnorhina tibicen).**

RECOMMENDATION 8

**The Agriculture Protection Board, in conjunction with the Department of Agriculture, should investigate the possibility of using the European Wild rabbit (Oryctolagus cuniculus) as a means of monitoring organochlorine (and other) pesticide residues in WA land and vegetation.**

The APB has carried out excellent work on the natural resistance of Western Australian wildlife to 1080 poison. This should be continued with field monitoring to ensure that the continued use of 1080 baits does not endanger native animals.

## 6.4 WATER

The aquatic component of the environment is monitored for pesticide residues much more rigorously than any others. This is because water is used for critical beneficial uses - eg human consumption; it supports organisms which are often very sensitive to pesticide residues; and most pesticides invariably end up in water.

It is convenient to consider the different components of the aquatic ecosystem separately.

Wetlands

Perth's groundwater provides the basis of the series of wetland lakes and swamps which run more or less north to south from Pinjar to Forrestdale. The environmental quality of these wetlands (with respect to pesticides) depends on the quality of the water supplying them, as well as the quantity of pesticides added for insect control.

There is ample evidence that the pesticide load of these wetlands, particularly the organochlorine insecticides, has increased in recent years, both as a result of their use in urban pest control, and in Argentine Ant control. Recent studies have shown that these levels could be responsible for changes in the invertebrate ecology of these lakes (Chambers J M & Davis J A 1988).

The organochlorines are no longer used in agriculture nor for Argentine Ant control, but their use in the building industry continues. It is therefore important that these pesticides continue to be monitored in wetlands to ensure that levels do not increase further, nor that further environmental degradation takes place.

RECOMMENDATION 13

**The Department of Conservation and Land Management, as the manager of Western Australia's fauna, in conjunction with other managers of wetlands, should monitor wetlands for pesticide residues, and their effects on wetland ecology.**

6.4.2 MARINE

The marine component of the environment is by far the least understood from the pesticide contamination point of view. Only two attempts have been made (Chegwidden 1979 and 1981) to determine pesticide residue levels in WA marine waters.

Given the relatively low residue levels of organochlorine insecticides in our rivers and estuaries, one would expect that levels in sea water would be virtually undetectable. However, both of Chegwidden's reports have found levels of dieldrin, for example, up to 0.027 $\mu$g/L in water, and in Cockburn Sound, 4 $\mu$g/kg of sediment.

Regular sampling of marine waters is carried out by the Department of Marine and Harbours, particularly in boat harbours. Samples are taken for analysis for nutrients, heavy metals and physical properties. It would not be difficult or expensive to extend this sampling to include sediments as well as water, and arrange for their analysis for organochlorine pesticides.

RECOMMENDATION 14

**The Department of Marine and Harbours should extend their harbour water sampling programme to include sediments, and analysis for pesticide residues.**

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# Response to the report 'Monitoring Pesticides - A Review'

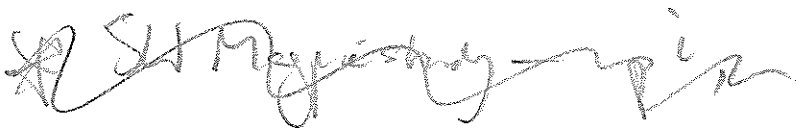
Report and recommendations of the Environmental Protection Authority

SW Maggie study — pp 1, 3, 18

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# Response to the report 'Monitoring Pesticides - A Review'

Report and recommendations of the Environmental Protection Authority



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# Preface

In Western Australia there have been a number of suspected cases where adverse environmental impacts related to pesticide use have occurred. They range from localised patches of dead vegetation along railway reserves to organochlorine pesticide contamination of many soils and water courses in south-west WA. Pesticide contamination is a potentially important environmental problem, but often its effects are not immediately observable, and therefore the documented cases may not give a true indication of the scale of the problem. Consequently, in WA this issue tends to be neglected in the face of the more obvious and immediately demanding environmental problems of salinity, eutrophication, clearing of native vegetation, industrial waste discharges, and others.

Concerns over pesticide issues have been increasing both within Australia and overseas, as indicated by the following examples:

- the United States has recently publicised its decision to lower the permitted Maximum Residue Limits (MRLs) for contaminants (including pesticides) in imported foods;
- the recently released 'Report of the Senate Select Committee on Agricultural and Veterinary Chemicals in Australia' (The Parliament of the Commonwealth of Australia, 1990);
- the report 'Pesticides: Issues and Options for New Zealand' recently released by the New Zealand Ministry for the Environment (MacIntyre et al, 1989); and
- a draft OECD Act which would essentially be an international agreement for the investigation and control of existing chemicals in the environment and to which Australia is considering becoming a party.

There is clearly an increasing community expectation for Government to assume the responsibility of better managing pesticide use to minimise adverse impacts on both the environment and public health. The Environmental Protection Authority's concern over these issues prompted it to commission the report 'Monitoring Pesticides - A Review' by Mr P Rutherford, pesticide co-ordinator of the WA Department of Agriculture.

This bulletin is the Authority's response to the recommendations contained in the Rutherford report, and to the submissions received on it.

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# Recommendations

The recommendations of the Environmental Protection Authority are:

## Recommendation 1

**The Environmental Protection Authority recommends that the Pesticides Advisory Committee (PAC) should coordinate pesticide-related environmental monitoring programmes and make recommendations to the appropriate agencies to assist with the coordination of environmental and health pesticide management and policy issues across government.**

## Recommendation 2

**The Environmental Protection Authority recommends that the Pesticides Advisory Committee should be responsible for ensuring that the results of pesticide-related environmental monitoring programmes are made public.**

## Recommendation 3

**The Environmental Protection Authority recommends that the WA Department of Occupational Health Safety and Welfare and the Environmental Protection Authority be given formal membership on the Pesticides Advisory Committee.**

## Recommendation 4

**The Environmental Protection Authority recommends that the Pesticides Advisory Committee should advise on the resources required to enable programmes of pesticide monitoring, assessment, management and policy formulation to be adequately prioritised and addressed.**

## Recommendation 5

**The Environmental Protection Authority recommends that the following programmes should be initiated by the Pesticides Advisory Committee as a matter of priority:**

- **the environmental hazard posed by pesticide residues in the aquatic environment should be determined, with specific investigation of:**
  - **wetlands and the effect of pesticides on aquatic ecology;**
  - **river and estuarine systems, and the effect of pesticides on the associated flora and fauna;**
  - **the effect of transient pulses of pesticides from spraying programmes on stream and river communities; and**
  - **rainfall, groundwater under rubbish tips, harbour waters and sediments;**
- **the environmental hazard posed by agricultural spray drift and pest control operations to native terrestrial flora and fauna, and particularly to the ecosystems contained within Reserves and National Parks;**
- **the desirability of a systematic/opportunistic pesticide monitoring programme on the Australian Magpie (*Gymnorhina tibicen*) and the European Wild Rabbit (*Oryctolagus cuniculus*) should be determined;**
- **the fate of pesticides in Western Australian soils should be investigated;**

## Recommendation 6

The Environmental Protection Authority recommends that the data collected by the Department of Agriculture on organochlorine pesticide contamination in Western Australian soils should be analysed and reported so that organochlorine pesticide monitoring programmes can be appropriately designed and executed.

## Recommendation 7

The Environmental Protection Authority recommends that the Roadside Conservation Committee should continue to investigate reports of herbicide damage to native vegetation and should recommend to the Pesticides Advisory Committee ways of minimising the problem.

## Recommendation 8

The Environmental Protection Authority recommends that Integrated Pest Management (IPM) methods should be investigated by the Department of Agriculture, Department of Conservation and Land Management and other relevant organisations, and promoted to the rural community.

## Recommendation 9

The Environmental Protection Authority recommends that the Health Department and the Department of Agriculture should investigate ways of ensuring that pesticides and empty pesticide containers are stored and/or disposed in an environmentally responsible manner, particularly in rural areas. (This may require the use of legislation, guidelines and public education and should be supervised by the Pesticides Advisory Committee).

## Recommendation 10

The Environmental Protection Authority recommends that the Government should encourage the chemical industry to introduce reusable containers and investigate the feasibility of deposit legislation for these containers.

## Recommendation 11

The Environmental Protection Authority recommends that the Government should expedite implementation of the Draft Dangerous Goods Regulations.

# 1. Introduction

Since the 1940s chemical use for the control of pest species such as disease transmitting insects, crop damaging organisms, nuisance insects, weeds, fungi and bacteria has become of increasing importance. Pesticides were considered to be a solution to world food shortages and health problems. Now society as a whole relies upon the use of pesticides for primary production and disease control, and the world's food supply and economy would be threatened if pesticides were withdrawn from use.

Apart from the obvious benefits gained from pesticides, a number of undesirable effects have become apparent since the advent of their use. Long-term effects of exposure have been recognised and as a result health and environmental criteria for acceptable pesticide exposure levels are continually being revised as new information becomes available. Consequently newer pesticides which are more specific, and therefore environmentally safer, are being developed. As the older pesticides become obsolete, or are banned, an additional problem is raised, that of safe pesticide storage and disposal. It is essential that adequate provision is made for pesticides to be easily stored or disposed of so as to provide long-term protection for human health and the environment.

In Western Australia alone the agrochemical industry made approximately $70 million worth of sales in 1987, of which over 80% was herbicide (Figure 1), for treating approximately 29% or 4.6 million hectares of the agricultural land in the State. Moreover, the report of the Senate Select Committee on Agricultural and Veterinary Chemicals in Australia (The Parliament of the Commonwealth of Australia, 1990) estimates that 7.5 million hectares of agricultural land are sprayed from the air each year in Australia.

There is also a significant and growing market for chemicals that are used for non-agricultural purposes. Of the approximately 274 active chemicals registered in 1986 for use as pesticides in WA, almost half were registered for non-agricultural use, although a much smaller proportion of the sales were for non-agricultural uses.

In Western Australia, as has occurred elsewhere in the world, there has been an increase in understanding of the adverse effects of pesticides on non-target organisms. However, to date most of the government effort has focused on human health issues. The current State Government has a statutory advisory committee established under the Health Act to deal with health-related issues, including the registration of pesticides for use in WA.

The Environmental Protection Authority (EPA) of WA has become concerned that the issue of pesticides in the environment, both management and monitoring, is not being adequately addressed. For this reason in 1987 Mr P Rutherford was seconded to the EPA from the Department of Agriculture to review pesticide use and monitoring in the State. The objectives of his study were three-fold:

- To review existing patterns of pesticide use in Western Australia and identify actual and potential environmental impacts;
- To review past and current procedures conducted by the State Government and other agencies for monitoring the environmental impact of pesticides and discuss the adequacy of the existing programmes on an ecosystem basis; and
- To make recommendations to the EPA regarding future monitoring requirements, and other actions necessary to eliminate or minimise the adverse environmental effects of pesticides.

The Rutherford report was completed as EPA Bulletin 407 (Rutherford, 1989) and released for public comment in December 1989. Submissions were also elicited from a number of State government agencies. Fifteen submissions were received, and these are summarised in the Appendix.

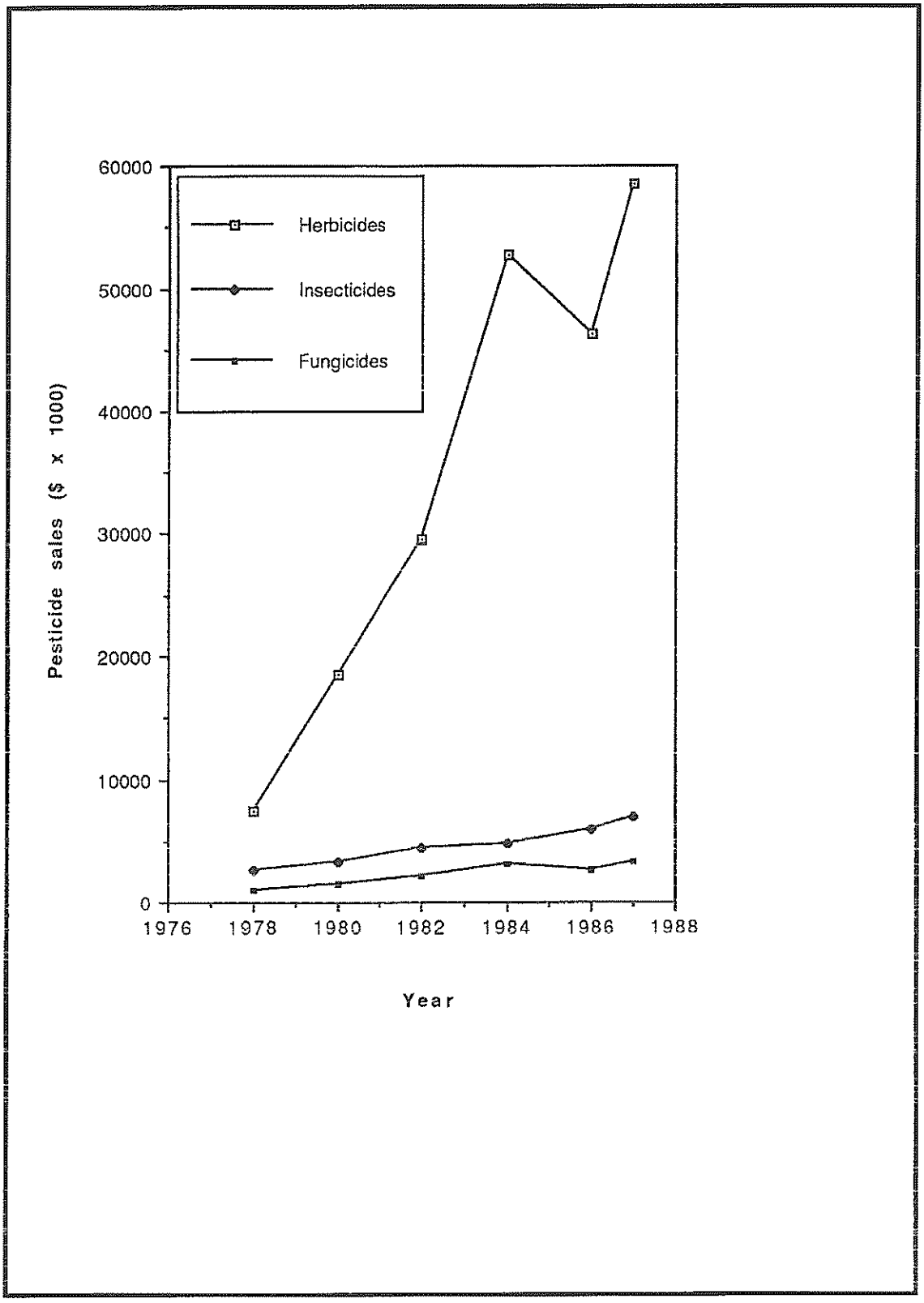



*Figure 1: Pesticide sales for Western Australia (data from Bulletin 407 (Rutherford, 1989))*

# 2. Summary of the Rutherford Report

The report considered the effects of pesticides, as defined in the Health Regulations of the Health Act, on the natural and physical environment, including soil, water, air and all native animals and plants.

The report briefly discusses the pesticides used in WA, the methods of application and associated potential and actual environmental impacts for a range of associated agricultural and non-agricultural activities such as: manufacture and formulation, transport and storage, disposal of surplus pesticide and used containers, cultivation of broadacre crops and pastures, horticulture, grain protection, animal husbandry, declared plant and animal control, forestry, industrial weed control, aquatic weed control, commercial pest control, Argentine Ant control and mosquito/midge control. Horticultural crops were identified as the most intensive users of agrochemicals, often receiving several applications of chemicals over a growing season. Methods of application were similar for a wide range of activities. Some of the more commonly used methods of application include boomspray, mister, knapsack, single nozzle sprayer and aerial techniques. The predominant actual and potential environmental impacts common to most pesticide activities, and those which should be of most concern, were identified in the report as follows:

- contamination of surface water (eg. water courses and waterbodies);
- contamination of groundwater;
- contamination of soil;
- contamination of air; and
- adverse impacts on non-target species of fauna and flora.

The report also gave a review of past and present-pesticide related environmental monitoring programmes conducted by WA government agencies, CSIRO and tertiary institutions. These are listed below by agency.

**Department of Agriculture:**

Pesticide investigations carried out by the Department of Agriculture have mainly been issue-based, dealing predominantly with effects on agricultural production and, to some extent, the fate of the pesticides after their application.

- Airborne 2,4-D and tomato damage at Geraldton;
- Long-term effects of herbicides in cropping systems;
- Organochlorine levels in soil, pasture and water at Lake Neerabup;
- DDT levels in soil, crop and pasture, water and sediment as a result of its use in cereal cropping;
- Insecticide residues in agricultural soils (organochlorines); and
- Miscellaneous monitoring work.

**Agriculture Protection Board:**

- Herbicide residues in flowing streams as a result of Blackberry control;
- Non-target fauna — effect of dingo baiting; and
- Fenitrothion levels in the environment after locust spraying campaign, 1982.

**Department of Conservation and Land Management:**

- Organochlorine residues in the Western or Australian Magpie;
- Pesticide levels after Plague Locust spraying operations; and
- Miscellaneous residue levels in birds.

**Environmental Protection Authority:**

- Pesticide residue levels in Cockburn Sound;
- Study to establish baseline levels of contaminants and nutrients in marine waters of WA; and

- A preliminary study of pesticides in rivers and estuaries of WA.

**Fisheries Department:**

- Pesticides in Marron; and
- Miscellaneous pesticide monitoring.

**Chemistry Centre of WA:**

- Report on pesticide residue sampling for the Ord River irrigation area 1964 - 1978 (Gorman, 1979); and
- Dieldrin residues— a Western Australian study (Shewchuk, 1981).

**Water Authority of WA:**

- Monitoring of river systems and reservoirs for contaminants, including pesticides, at several levels under several different programmes;
- Groundwater monitoring at CIK Pty Ltd in Kwinana;
- Routine monitoring of groundwater production bores;
- Routine monitoring of waste disposal sites; and
- Soil sampling in the south-west.

**Waterways Commission:**

- Heavy metals in sediments and mussels of the Swan River system;
- Heavy metals and pesticides in surface sediments near slipping facilities on the Swan River;
- Swan Canning Estuarine System: Environment Use and the Future (Thurlow et al, 1986);
- Organochlorine pesticide residues in the Preston River (Atkins, 1982; Klemm, 1989) and ongoing in the Preston and Collie Rivers; and
- Avon River System Fact Finding Study (Hansen, 1986).

**CSIRO:**

- An EPA commissioned report 'Organochlorine residues in sediments and soils in and around Lake Goolellal' (Gerritse, 1988).

**Curtin University of Technology:**

- Pesticide Residues around Swan Coastal Plain Lakes (Ford and Stacey, 1983).

**Murdoch University:**

- Herdsman Lake Pesticide Study - Interim Report (Davis and Garland, 1986) plus subsequent studies;
- Forrestdale Lake Chironomid Study (Davis et al, 1987); and
- Investigations into more Effective Control of Nuisance Chironomids (non-biting midges) in Metropolitan Wetlands, Perth, WA (Davis et al, 1988).

The report identifies the organochlorine insecticides as being potentially the most environmentally threatening of the pesticides. It concludes that pesticide contamination in the air is insignificant and that further substantial environmental monitoring in this regard is unnecessary, but that the effects of contamination in the soil, on native vegetation, in groundwater and in aquatic and marine environments require further investigation. The report considers that previous environmental monitoring programmes, particularly for streams and rivers, had been rather ad hoc and uncoordinated and that a structure is therefore required to coordinate future work on an across government basis.

The recommendations of the Rutherford report are contained in the Appendix together with a summary of the received submissions.

# 3. Discussion of EPA recommendations

The EPA accepts the broad thrust of the Rutherford report and its recommendations. However, from suggestions made in submissions, and from further consideration by the Authority, some additional recommendations are made in this report. Some of the recommendations contained in the Rutherford report have been amalgamated in the EPA's recommendations, or have already been implemented. The Rutherford recommendations concentrated on the organochlorine insecticides, however, the Environmental Protection Authority considers that the intent of its recommendations should be broadened to include all pesticides. Many of the chemicals that have replaced the organochlorines are certainly much less persistent, but are more toxic.

## 3.1 Programme coordination

There are many cases of pesticide contamination of agricultural soils and some evidence of contamination in aquatic environments in WA. There are also a number of suspected cases where wildlife have been poisoned by pesticides, but these are very difficult to prove.

Organochlorine pesticide residues have been detected in many of Western Australia's aquatic ecosystems. A recent EPA survey of several river systems in the south-west of the State revealed that many of these rivers contain concentrations above the EPA criteria for the preservation of aquatic ecosystems as published in DCE (now EPA) Bulletin 103 (DCE, 1981). These pesticides have recently been banned from almost all agricultural uses and therefore environmental contamination should slowly reduce as the chemicals break down. As already mentioned, many of the chemicals used in the place of organochlorines (eg. organophosphates) are more toxic to animals, but break down much more quickly. Hence long-term contamination of the environment and accumulation in ecosystems is less likely to occur, however, impacts on non-target organisms may be more pronounced unless new broad spectrum pesticides are used with care.

Pesticides have become an integral part of everyday life, serving a number of important functions such as pest control and enhancement of primary production. For this reason some pesticides may always have a place in our society, however, their use should always be managed in such a way as to reduce any adverse environmental impacts. Unfortunately there is no government mechanism to determine the environmental acceptability of agricultural chemicals, or appropriate methods for their use, in Western Australia. Some environmental pesticide monitoring programmes have been carried out by a number of government agencies and tertiary institutions, but almost always in response to a particular issue that was prominent at the time and never with a pro-active objective. Some exceptions are the efficacy investigations carried out by the Department of Agriculture, but they have little relevance to environmental issues. The problem is that too few resources are committed to determining the adverse environmental impacts of agrochemicals. This problem is not confined to WA and has also been highlighted in two other recent reports:

- Pesticides: Issues and Options for New Zealand published by the New Zealand Ministry for the Environment (MacIntyre et al, 1989);
- Report of the Senate Select Committee on Agricultural and Veterinary Chemicals in Australia (The Parliament of the Commonwealth of Australia, 1990).

The Government has a clear responsibility to the community to ensure that the environment is maintained in a healthy and resilient state. There are only two legislative controls that the State Government may use to prevent contamination of the natural environment by pesticide use. Under Part V of the Environmental Protection Act, the act of contamination could be termed pollution and the polluter, if an individual, fined $10 000 (or 6 months imprisonment) and $2 000 per day of continued pollution, or $20 000 and $4 000 daily, if the polluter is a body corporate, and ordered to pay for the cost of clean-up. Action taken under Part V of the Environmental Protection Act is reactive, and does not fulfil the requirements outlined above. The Health Department has extensive control of the registration and use of pesticides within the State in regard to health matters. A Pesticides Advisory Committee (PAC) has been established under the Health Act and has a statutory responsibility to advise the Minister for Health on pesticide-related health matters, and also on the registration of pesticides for use in WA. It also provides advice on the use and disposal of pesticides to minimise the

risk to human health. Membership of the PAC consists of two representatives from the Health Department (Chairman and Secretary), and representatives from the Chemistry Centre of WA and the Department of Agriculture. The EPA and the Department of Occupational Health, Safety and Welfare have observer status only at PAC meetings. Unfortunately ecosystems are more sensitive to pesticides than are humans and therefore require further protection.

To provide effective advice, guidance and control on pesticide use and associated adverse environmental impacts, the Western Australian Government must commit adequate resources to the area and develop a strategy which ensures a coordinated Government approach. The government agencies who promote the use of pesticides should be part of the strategy, along with the agencies with responsibility for managing the environment.

An appropriate agency for implementing or coordinating this strategy would appear at first sight to be the Environmental Protection Authority since it administers the legislation of the Environmental Protection Act. However, efficient across government coordination is unlikely without the formation of a new committee which includes representatives from all the other relevant government agencies. The Pesticides Advisory Committee, under the Minister for Health, may therefore be the most appropriate agency for this role if it were expanded to include environmental issues. The committee should be independent and should provide a focal point for the dissemination of information and advice on policy matters relating to the effects of pesticides on the environment and health, and for the responsibility of coordinating monitoring and management programmes within the State. It should be concerned with monitoring the fate and impacts of pesticides in the environment and toxicity to local species, and should ensure that the information is made available to the public. It should be involved in making recommendations to the Minister for Health, the Minister for Environment and the Western Australian Advisory Committee on Hazardous Substances (WAACHS) on policy. The committee should also ensure the coordination of funding for priority projects. Given the heavy work load expected of the committee it may need full time staff resources allocated in addition to relying on the resources of its member agencies to carry out the work. The Authority therefore supports Recommendation 15 of the Rutherford report and proposes the following recommendations:

## Recommendation 1

**The Environmental Protection Authority recommends that the Pesticides Advisory Committee (PAC) should coordinate pesticide-related environmental monitoring programmes and make recommendations to the appropriate agencies to assist with the coordination of environmental and health pesticide management and policy issues across government.**

## Recommendation 2

**The Environmental Protection Authority recommends that the Pesticides Advisory Committee should be responsible for ensuring that the results of pesticide-related environmental monitoring programmes are made public.**

Recommendation 1 is the most important of this report. The thrust of the other recommendations would be the brief of this committee and therefore considerable discussion and effort is required to develop an effective structure. Since the brief of the PAC would be much broader if it also dealt with environmental issues, it is the EPA's view that the PAC membership should also include representation from the Environment Portfolio. The EPA understands that amendment of the Health Act to formally include the EPA and Department of Occupational Health Safety and Welfare on the PAC is in process. The EPA fully supports the proposed change.

## Recommendation 3

**The Environmental Protection Authority recommends that the WA Department of Occupational Health Safety and Welfare and the Environmental Protection Authority be given formal membership on the Pesticides Advisory Committee.**

For the PAC to effectively deal with issues relating to pesticides and the environment it may be necessary to form a subcommittee which reports to it. This has been endorsed by WAACHS and the Health Department for implementation.

The Authority envisages that membership of the subcommittee would include representatives from the following government departments:

- Environmental Protection Authority;
- Chemistry Centre;
- Department of Agriculture;
- Agriculture Protection Board;
- Department of Conservation and Land Management;
- Department of Local Government; and
- Water Authority of WA.

Representation from the Waterways Commission, Main Roads Department and Westrail may also be considered appropriate to increase the resources available to the Committee.

The Committee would continue to report to the Minister for Health in an advisory capacity and for input into policy formulation. Reporting to the Minister for Environment would be on a formal basis through the Minister for Health, and/or through EPA representation. The Committee would maintain its role in the pesticide registration process.

In addition to the committed resources of its member agencies, the Committee may need additional resourcing for administration and investigations, or to contract professional assistance. In this case potential sources which Government may consider for fund generation should be on a polluter pays basis and could include grants from those agencies which promote pesticide use, a tax on the agrochemical companies or an environmental levy on all pesticide purchases. The funding mechanism would need to be built into the structure under which the Committee works. The New Zealand Ministry for the Environment report 'Pesticides: Issues and Options for New Zealand' (MacIntyre et al, 1989) gives an excellent detailed discussion of funding alternatives for New Zealand Government involvement in the areas of risk assessment, environmental research and residue monitoring, education/training and labelling, and the research, development and dissemination of low pesticide use alternatives. These funding options are listed below:

- general tax revenue;
- registration charges;
- charges for the renewal of registrations;
- taxing pesticide use (a tax on company turnover, or on active ingredient);
- direct charges for services;
- producer board (growers) levies; and
- joint funding (of all or some of the above).

### Recommendation 4

**The Environmental Protection Authority recommends that the Pesticides Advisory Committee should advise on the resources required to enable programmes of pesticide monitoring, assessment, management and policy formulation to be adequately prioritised and addressed.**

## 3.2 Aquatic systems

Examples of pesticide application directly to aquatic systems are few. Probably the most common examples would be midge and mosquito control programmes and the use of antifouling paints on the bottom of boats.

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- Environmental Protection Authority;
- Chemistry Centre;
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- Department of Conservation and Land Management;
- Department of Local Government; and
- Water Authority of WA.

Representation from the Waterways Commission, Main Roads Department and Westrail may also be considered appropriate to increase the resources available to the Committee. Representation from the community should also be considered to facilitate EPA Recommendation 2.

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## 3.2 Aquatic systems

Examples of pesticide application directly to aquatic systems are few. Probably the most common examples would be midge and mosquito control programmes and the use of antifouling paints on the bottom of boats.

Many of the lakes in the Perth metropolitan region have become eutrophic and now support nuisance populations of insect pests such as midges and mosquitos. Pesticides are generally applied directly to the lakes for control of these pests at the larval stage. Midge species have been monitored extensively around some of the major lakes to determine the effectiveness of the control programmes. However, many other non-target aquatic species are also susceptible to the control chemicals, and are killed. Until recently, these impacts had not been considered. Investigations are now in place to determine more effective and environmentally acceptable methods of control.

Antifouling paints contain chemicals to either discourage organisms from attaching to the bottom of boats or kill them after they have settled. These chemicals leach from the painted surfaces and have been found to accumulate in the sediments of enclosed areas such as harbours, bays and estuaries. Some are persistent and can accumulate down the food chain. They are toxic to non-target marine organisms, some at extremely low levels, and in extreme situations have been known to cause fish kills. For example tributyl tin has been shown to interfere with the reproductive processes of the female Dog Whelk at levels below 0.002 µg/L (Bryan et al, 1988).

Some pesticides applied to the land find their way into aquatic systems. The transport mechanisms involved are predominantly two-fold. The first is by spray drift extending beyond the boundaries of the target areas and settling directly onto the surface of nearby waters. This form of contamination can be minimised with appropriate management practices at the time of application (eg. buffer zones and appropriate wind conditions). Probably the majority of pesticide detected in aquatic environments has been leached from the treated areas by rainfall. The main mechanism appears to be surface runoff during and immediately after rainfall. A recent programme in the south-west which monitored herbicide concentrations in streams after it was applied to adjacent catchments found that peak concentrations occurred during heavy rainfall (McAlpine, 1990). This is substantiated by other studies conducted overseas (Bouchard, 1985; Neary et al, 1983; Lavy et al, 1989). Appropriate management techniques can be used to reduce the quantity of pesticide residue exported from the treated area by reducing the quantity of runoff. In the leached sandy soils that are particularly common on the coastal plains of WA, transport by groundwater movement may also be an important mechanism. Laboratory studies using a range of pesticides in leaching columns have shown that greatest mobility occurs in sandy soils (Helling, 1970; Council for Agricultural Science and Technology, 1985) and the pesticides could therefore accumulate in groundwater below the zone of biological activity where chemical breakdown is slow. There are reported cases of low persistence pesticides (other than the persistent organochlorines) accumulating in groundwater in both Europe and the United States (Williams et al, 1988; International Environment Reporter, 1989).

The effects of agrochemicals on the Western Australian flora and fauna has been largely ignored but this information is vital for their protection and for the environmental assessment of operations involving pesticides and for the development of monitoring programmes. The water quality criteria that are generally used as acceptable limits of contamination are based on toxicity studies carried out in the northern hemisphere on species that are not found in Australia and under conditions that may have no relationship to local conditions. Monitoring programmes and other investigations coordinated by the Pesticides Advisory Committee should include relevant toxicity studies.

## 3.3 Terrestrial systems

Most pesticides are used in the terrestrial environment for a wide range of reasons, ranging from weed and disease control to insect and mammal pest control. Most of the chemicals are applied to agricultural land by aerial, mister or boomspray equipment, depending on topography, size of the area to be treated, the target, etc. They are used throughout the year and therefore over a range of climatic conditions, and in WA the conditions are extreme, from cold and very wet to hot and very dry. As a result the fate (persistence, mobility and distribution) of the applied chemical will vary since it is depends on temperature, rainfall, moisture etc. There has been very little work carried out in WA on the fate of pesticide residues under local conditions, however, there are models that simulate chemical degradation and mobility in soils and these may be applicable to our situation.

Studies on the environmental fate of agrochemicals are particularly important in areas of heavy use, for example areas of intensive horticulture or areas that are heavily infested with pests such as Argentine Ants. As discussed earlier many of the chemicals used today are not as persistent as the

organochlorines but are often more toxic and therefore have a high potential for adverse environmental impact.

A number of pesticides are used in natural ecosystems for control of declared animal and plant pest species. This is usually carried out on the assumption that both the economic and the environmental impact of the control pesticide is less than that of an alternative method of control or of not controlling the pest. This is often just an assumption and needs to be considered more carefully by implementing a programme to adequately investigate the impacts of the chemicals on native species. These investigations are also required for areas where pesticides applied for agricultural purposes may drift and/or leach into natural environments and to which native species may consequently be exposed.

The majority of pesticide application is in the form of a liquid (atomised) spray which is easily transported several kilometres by either very light or strong winds (Gilbey et al, 1984), shown in Figure 2. As a result the effectiveness of spraying in adverse wind conditions has been questioned because a large proportion of the spray can be lost from the target area. There have been a number of cases where crops have been damaged by pesticides applied to different crops upwind (Gilbey et al, 1984). In this instance the persons responsible for spraying are legally liable for any damage to crops downwind. Guidelines have therefore been provided for the correct conditions of application. However, the fact that crops can be damaged downwind of spraying operations also has obvious implications for natural ecosystems. Taller vegetation in particular has a tendency to accumulate airborne particles including droplets of pesticide. As a result the margins of reserves and road reserves may need special attention in areas of heavy use since the natural vegetation is generally taller than surrounding crops. It may be necessary to develop appropriate strategies to protect natural environments, particularly reserves, and to reduce spray drift during application.

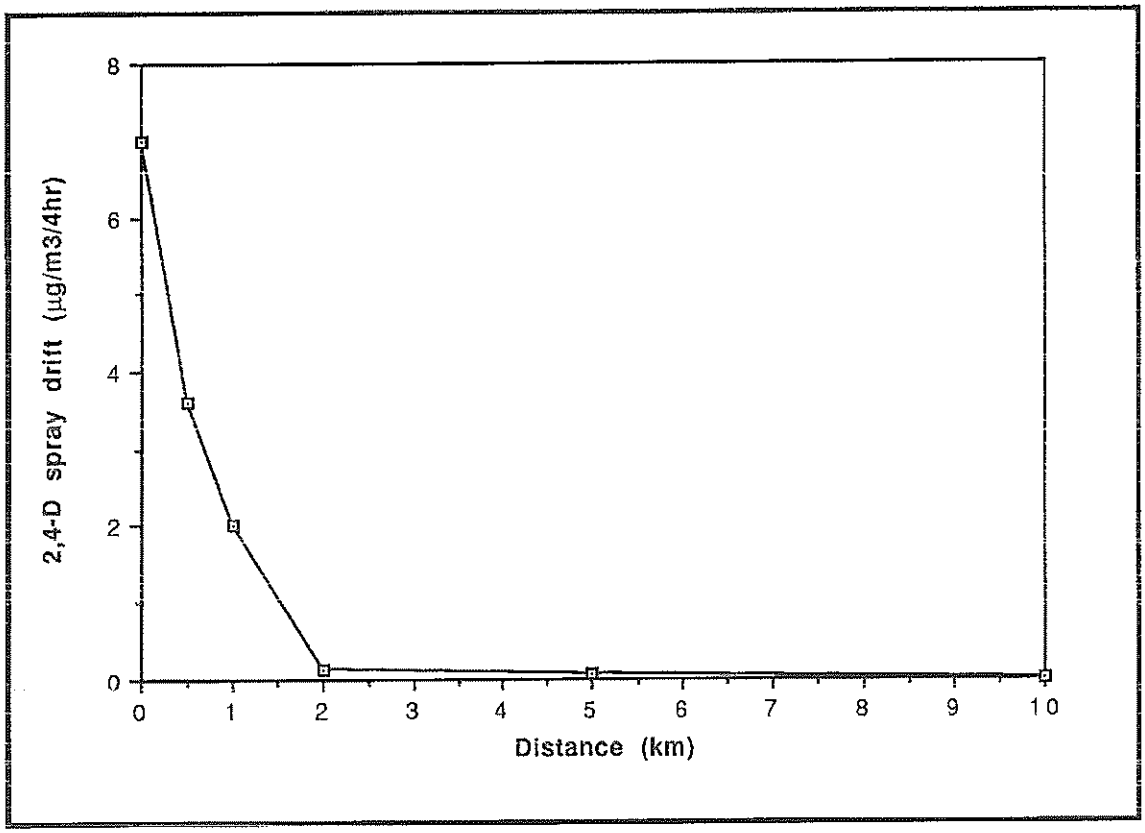



*Figure 2: Downwind spray drift measured after 2,4-D application near Geraldton, WA (data from Gilbey et al, 1984)*

Overseas studies have also identified an increase in nutrient export from catchments sprayed with herbicides (Neary et al, 1986). This appears to be a result of an increase in the quantity of decomposing organic matter, increased runoff because of lost transpiration and from the stimulation/inhibition of soil micro-organisms (eg. denitrifying bacteria)(Wardrop, undated), many of which can be quite sensitive to the applied chemicals . Apart from the obvious consequence of increased nutrient input to WA's already nutrient threatened waterbodies of the south-west, exposure of the soil microfauna to pesticides may secondarily affect the associated floral communities.

Recommendations 7 to 14 of the Rutherford report have been supported by the Authority and included in Recommendation 5 below.

### Recommendation 5

**The Environmental Protection Authority recommends that the following programmes should be initiated by the Pesticides Advisory Committee as a matter of priority:**

- **the environmental hazard posed by pesticide residues in the aquatic environment should be determined, with specific investigation of:**
  - **wetlands and the effect of pesticides on aquatic ecology;**
  - **river and estuarine systems, and the effect of pesticides on the associated flora and fauna;**
  - **the effect of transient pulses of pesticides from spraying programmes on stream and river communities; and**
  - **rainfall, groundwater under rubbish tips, harbour waters and sediments;**
- **the environmental hazard posed by agricultural spray drift and pest control operations to native terrestrial flora and fauna, and particularly to the ecosystems contained within Reserves and National Parks;**
- **the desirability of a systematic/opportunistic pesticide monitoring programme on the Australian Magpie (*Gymnorhina tibicen*) and the European Wild Rabbit (*Oryctolagus cuniculus*) should be determined;**
- **the fate of pesticides in Western Australian soils should be investigated.**

### Recommendation 6

**The Environmental Protection Authority recommends that the data collected by the Department of Agriculture on organochlorine pesticide contamination in Western Australian soils should be analysed and reported so that organochlorine pesticide monitoring programmes can be appropriately designed and executed.**

Recommendation 6 of the Rutherford report has been supported by the Authority and included as Recommendation 7 below.

### Recommendation 7

**The Environmental Protection Authority recommends that the Roadside Conservation Committee should continue to investigate reports of herbicide damage to native vegetation and should recommend to the Pesticides Advisory Committee ways of minimising the problem.**

## 3.4 Management of pesticides

The controls currently on pesticide use in WA are predominantly related to the potential human health hazards associated with their use. Current mechanisms for the protection of the environment from pesticides are inadequate, mainly because the impacts often have not been determined. Pesticides

are readily available in our society and reasonably easy to use, which often leads to their over-use because of insufficient education or poor management practices. Currently there are no accurate statistics kept on pesticide use in the State apart from data that the Agricultural and Veterinary Chemical Association (AVCA) can supply based on sales from their member companies. This may be satisfactory in the short term, but in the long term Government may need to give some consideration to collecting accurate statistics on pesticide use.

The most effective method of preventing adverse environmental impacts from agrochemicals is to prevent their use, but this is not practical. However, adverse environmental effects can be minimised by introducing appropriate management techniques, known as Integrated Pesticide Management (IPM) strategies. These are strategies that involve using small quantities of selective, low persistence chemicals at critical times in an environmentally-responsible manner, and using other preventative techniques to reduce pest build up. The expected result of introducing IPM would be a reduction in the quantity of pesticide used, but with an increase in the variety of pesticides available since many current pesticides are broad spectrum chemicals which act against a wide variety of organisms. In addition to reducing potential environmental impacts, IPM strategies are expected to reduce pest resistance to pesticides. IPM should be an attitude as much as a strategy and would require ongoing commitment and liaison between relevant government departments (mainly the Department of Agriculture, the Agriculture Protection Board and the Department of Conservation and Land Management), the chemical industry and the user groups. It should involve assessing the appropriateness of new chemicals quickly, and the investigation of alternative pest control procedures, and should include an education component to ensure that up-to-date information is available to the pesticide users. This would probably best be coordinated by the WA Department of Agriculture. The recently released Report of the Senate Select Committee on Agricultural and Veterinary Chemicals in Australia (The Parliament of the Commonwealth of Australia, 1990) also suggested that pesticide education for users was essential to ensure their responsible and judicious use, but that it may have to be formalised by licensing all those who apply pesticides.

Many farmers tend to buy large quantities of pesticide and store it until it is required. This practice has two main associated problems: the problem of safe storage and the problem of accumulating old stock. Often chemicals are stored in locations of high risk or become outdated. Subsequent decomposition of the container or disaster, such as fire, may release these chemicals to the environment often with substantial local effect on either human health or the natural ecosystem. In other instances old stock has been disposed down a nearby watercourse, again with substantial adverse environmental impacts. An environmentally safe system for the storage and disposal of pesticides needs to be considered by Government and should come under the brief of the Pesticides Advisory Committee and its member agencies, particularly the Health Department and the Department of Agriculture. It will require a substantial effort to increase public awareness of the problem and to encourage participation. It may require legislation, for example to limit the quantity of pesticide that can be bought to the amount required for the job in hand.

The disposal of empty containers is another management problem associated with pesticide use, particularly in rural areas where substantial quantities are used, and is probably best dealt with on a regional basis. Used containers often still contain significant quantities of unused chemical and therefore need to be dealt with appropriately to reduce the risk of environmental contamination after they are discarded. The recycling of consumable goods containers is now becoming a common activity in the community and this should be actively encouraged for pesticide containers. Already one major chemical company is reusing pesticide containers, but there is still a need for Government to encourage the remainder of the chemical industry to introduce reusable or recyclable pesticide containers. Government should consider the introduction of deposit legislation to provide an incentive for the containers to be returned.

## Recommendation 8

**The Environmental Protection Authority recommends that Integrated Pest Management (IPM) methods should be investigated by the Department of Agriculture, Department of Conservation and Land Management and other relevant organisations, and promoted to the rural community.**

The Authority has supported the general thrust of recommendations 3, 4 and 5 of the Rutherford report and has amalgamated them into Recommendation 9.

### Recommendation 9

**The Environmental Protection Authority recommends that the Health Department and the Department of Agriculture should investigate ways of ensuring that pesticides and empty pesticide containers are stored and/or disposed in an environmentally responsible manner, particularly in rural areas. (This may require the use of legislation, guidelines and public education and should be supervised by the Pesticides Advisory Committee).**

### Recommendation 10

**The Environmental Protection Authority recommends that the Government should encourage the chemical industry to introduce reusable containers and investigate the feasibility of deposit legislation for these containers.**

Recommendation 1 of the Rutherford report has been implemented. The third schedule of the Explosives and Dangerous Goods Act has been amended to include Chronic Hazardous Substances. This has been proclaimed and will come into effect in three months. Schedule 5, 6 and 7 chemicals of the Poisons Act, which includes the more toxic pesticides, will be included as Chronic Hazardous Substances.

Recommendation 2 of Bulletin 407 is in process. Draft Dangerous Goods Regulations have been issued, public comments received and recommendations given to the Parliamentary Council early in 1990. The implementation of these regulations should be expedited.

### Recommendation 11

**The Environmental Protection Authority recommends that the Government should expedite implementation of the Draft Dangerous Goods Regulations.**

# 4. Conclusions

The Environmental Protection Authority considers that the recommendations contained in this report should be implemented forthwith. The implementation of the recommendations will improve the quality of the State's environment and enhance its protection. It may also benefit pesticide users such as the agricultural industry by improving farm economics and management techniques through IPM.

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# Appendix 1

## Summary of the responses arising from the submissions addressing the report to the Environmental Protection Authority, 'Monitoring Pesticides - A Review'.

(This report was released in December 1989 for public review. Comments were also solicited from relevant government departments before it was considered by the Environmental Protection Authority.)

## Submission responses addressing the recommendations

One submission commented that some of the recommendations are already in place, or in the process of being implemented.

### Recommendation 1

**The Government should give consideration to expanding the scope of the Dangerous Goods (Road Transport) Regulations 1983 to include those additional pesticides which are deemed by the Environmental Protection Authority to be of environmental concern.**

### Submissions:

1 The Explosives and Dangerous Goods Act has been amended to include a new class of dangerous goods, 'Chronic Hazardous Substances'. This has opened the way for Government to control the transport of Chronic Hazardous Substances such as pesticides if necessary.

### Recommendation 2:

**The Recommendations of the Stored Chemicals Sub-Committee, presented in its final report of February 1986, should be implemented as soon as possible.**

### Submissions:

1 The recommendations of the Stored Chemicals Sub-Committee regarding controlling the storage of dangerous goods in Western Australia have resulted in the formation of a Public Safety Sub-Committee which has drafted regulations for the storage of dangerous goods. The Draft Dangerous Goods Regulations 1989 have been circulated and a three-month period for public comment has closed. The responses are being reviewed and recommendations for amendment will be made to the Hon Minister for Mines for approval to implement the regulations as soon as possible.

### Recommendation 5:

**The Government should investigate ways of encouraging the use of pesticide drum-crushing contractors as a means of disposing of unwanted used containers.**

### Submissions:

1 The alternative of developing recycling of pesticide containers should be pursued.

### Recommendation 6:

**The Roadside Conservation Committee should continue to investigate reports of herbicide damage to native vegetation, and if necessary, recommend ways of minimising the problem.**

### Submissions:

1 The Roadside Conservation Committee is currently doing this for road and rail reserves. The Committee is also sponsoring small research projects relevant to this issue.

## Recommendation 7:

**The Department of Conservation and Land Management should re-introduce a monitoring programme for pesticide residues in the Australian Magpie (*Gymnorhina tibicen*).**

## Submissions:

1 One submission indicated concern that although the recommendation probably had some merit it was 'open-ended' and poorly defined.

2 It may be more appropriate for a research organisation to monitor pesticide levels in magpies rather than CALM fund and conduct the programme.

## Recommendation 8:

**The Agriculture Protection Board, in conjunction with the Department of Agriculture, should investigate the possibility of using the European Wild Rabbit (*Oryctolagus cuniculus*) as a means of monitoring organochlorine (and other) pesticide residues in WA land and vegetation.**

## Submissions:

1 Monitoring changes in field populations of birds and animals is resource consuming, and the results are generally inconclusive.

## Recommendation 9:

**The Water Authority of Western Australia should extend its pesticide residue monitoring programme to include all major river systems which drain agricultural land.**

## Submissions:

1 The benefit to the State and the logic that this programme be developed as an extension of the Water Authority's regular stream flow gauging and water quality programme is acknowledged. Funding for this programme, and various other initiatives proposed, needs to be considered in a "whole of Government" context, perhaps through the proposed committee in Recommendation 15.

2 All major river systems should be monitored for pollutants, including pesticides, salt and nutrients.

## Recommendation 11:

**A research project into the levels of pesticides found in rainfall over the coastal plain should be carried out by an appropriate body, such as the Chemistry Centre of WA, Murdoch University or CSIRO.**

## Submissions:

1 Further work into the understanding of the behaviour and attenuation of pesticides in soils of the coastal plain would be preferable to monitoring of pesticide concentrations in rainfall.

2 It is appropriate that Murdoch University become involved in measuring pesticide levels since their expertise in this area is increasing.

## Recommendation 13:

**The Department of Conservation and Land Management, as the manager of Western Australia's fauna, in conjunction with other managers of wetlands, should monitor wetlands for pesticide residues, and their effects on wetland ecology.**

## Submissions:

1 One submission indicated concern that although the recommendation probably had some merit it was 'open-ended' and poorly defined.

2 This recommendation was supported by one submission while underlining the 'in conjunction with other managers of wetlands'.

3 Species abundance and diversity surveys should be conducted on representative and important areas to serve as indicators of environmental problems.

## Recommendation 14:

**The Department of Marine and Harbours should extend their harbour water sampling programme to include sediments, and analysis for pesticide residues.**

## Submissions:

1 Contrary to the statement in 6.4.2 in the Bulletin the Department of Marine and Harbours does not carry out regular sampling of water and sediments in boat harbours. The Department will continue to support sampling of swimming areas on public health grounds and could take samples on behalf of an appropriately funded research body provided the necessary materials and directions were supplied.

## Recommendations 7, 8, 9, 10, 11, 12, 13, and 14:

## Submissions:

1 A review of these recommendations should be undertaken by key players prior to implementation. The Chemistry Centre of WA should be included because of work load implications.

## Recommendation 15:

**A Co-ordinating Committee for Environmental Monitoring of Pesticides should be established and serviced by the Department of Agriculture. It may be appropriate for the Committee to report to the WA Advisory Committee on Hazardous Substances (WAACHS).**

## Submissions:

1 Five submissions specifically support the establishment of such a committee and three suggest that it should report to the PAC which then advises WAACHS as appropriate.

2 This committee may have implications for WAACHS in that its advice and recommendations may effect Government policy.

3 This committee should not be serviced and administered by the Department of Agriculture since this would not be compatible with the public view that the Department supports pesticide use for agriculture. Administration by Health, CALM or EPA would be more appropriate.

4 Chemistry Centre of WA should be represented on this committee to ensure that appropriate resources are available for proposed monitoring.

5 The Water Authority would be pleased to participate in this committee if established.

6 A review of monitoring undertaken for health purposes should be included in the committee's terms of reference.

7 This committee, or one similar, should investigate means of reducing pesticide use in ways compatible with farmer requirements, but without adversely affecting the environment, involving such concepts as Integrated Pest Management.

8 This committee may be the forum to coordinate funding for the proposed initiatives in this report.

## Recommendation 16:

**The Department of Agriculture should increase its commitment of financial and human resources for the adequate monitoring of pesticides and the effects in the rural environment.**

## Submissions:

1 This recommendation should be broadened to include a health monitoring programme, involving the Health Department of WA and including reports by physicians of suspected pesticide related illness or injury.

## Recommendations 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, and 16:

## Submissions:

1 These recommendations should be ongoing.

2. Submission responses requiring consideration for additional recommendations:

   (i) Consideration should be given to involving input from outside Government into the process of assessing pesticides in the environment, perhaps through membership of relevant committees.

   (ii) As already mentioned in the submission comments under Recommendation 11, further investigation is needed into the behaviour and attenuation of pesticides in soils of the coastal plain.

   (iii) A 'market basket' pesticide monitoring programme should be included in the State's pesticide monitoring strategy. This would assist in controlling pesticide misuse, and give information on human pesticide intake.

   (iv) A monitoring programme looking at residue loads in the Western Australian human population should be carried out over the period of a year.

   (v) Statistics should be kept on the importation and sale of all pesticides in WA, probably by the Health Department of WA.

3. General submission responses on monitoring which would apply to the recommendations:

   (i) The agricultural use of organochlorines has been phased out as of July 1990, except for the limited and stringently controlled use of Mirex. It is unnecessary, therefore, to increase monitoring which will concentrate on organochlorines as it will only give us a history of what we already know.

   (ii) Most pesticide monitoring programmes tend to pick up the stable, bio-accumulating compounds. A major problem which needs to be addressed is how to monitor the environment for ephemeral pesticides which are generally much more toxic.

   (iii) Any aspects involving hydrogeology with respect to groundwater monitoring should be referred to Geological Survey of WA, Hydrogeology Branch, at the planning stage to ensure resource allocation and expert advice.

4. Submission responses addressing the report text:

(i) Metsulfuron-methyl should be moved to the list of APB widely used herbicides (page 19).

(ii) Phosphine fumigation of rabbit burrows is also used to control rabbits (page 20).

(iii) APB dingo baiting is carried out using 1080 with the exception of all wild dog/dingo baiting carried out in the south-west agricultural areas where strychnine is used (page 20).

(iv) On page 21 it is implied that the APB uses strychnine to bait feral pigs. While some primary producers may use this to poison feral pigs it is APB policy to use 1080.

(v) The pesticides malathion, methyl bromide, dichlorvos and carbaryl are also used to control grain insects (page 21).

(vi) Non-target poisoning of some native animal species may occur with the use of pindone. There are stringent precautions to prevent this (page 21).

(vii) There may be minor levels of strychnine residues left in the environment as a result of its use (page 21).

(viii) Improvement to the environment as a result of controlling declared animals should be discussed (page 21).

(ix) Generally granular pesticides are of little harm to higher animals as they have a clay base. If poisoning occurs, it is most likely to be via consumption of contaminated invertebrates (page 27).

(x) Aldrin and heptachlor are currently used widely, but dieldrin and chlordane were used extensively in the past (page 28).

(xi) Mirex is registered by the APB for control of the Darwin Termite. It is applied by trained operators under very stringent conditions and therefore there is little actual or potential environmental impact (page 28).

(xii) The document should discuss the Health Department air monitoring programme in houses which is measuring occupant exposure to termiticides (page 29).

(xiii) The statement on page 29 "There is no doubt that most of the organochlorine and organophosphate insecticide residues found in groundwater and in urban wetlands, originate from pest control activities in the Perth metropolitan area (Davis and Garland, 1986)" is misleading. In fact Davis' and Garland's work did not include analysis of insecticide residues in groundwater. The insecticide residues were identified in urban drainage entering the lakes. CSIRO information indicates that levels in groundwater are insignificant.

(xiv) The table on page 46 could be misleading because of poor levels of detection in the 1970s, and better detection but possible false positives in the 1980s.

(xv) On page 47 of the report reference is made to a lack of information on pesticide concentration in water at waste disposal sites. The Public Health Department have conducted several surveys of pesticide levels in leachate polluted groundwater and it is suggested that Sven Hansen be contacted for more detailed information.

(xvi) Organochlorine contamination in Lakes Carabooda and Goolelal is more likely a result of adjacent horticultural activities rather than Argentine Ant control (page 54.c).

(xvii) Further to CSIRO's work on pesticides on page 55. In a study into the effect of urbanisation on the quality of groundwater in Bassendean Sands, no significant pollution was detected. It was concluded that pollution of groundwater and surface water was only likely through movement of organochlorine pesticides with particulates or from illegal dumping of wastes by pest control operators.

(xviii) No organochlorines have been used around wetlands since 1984-85. The term 'recent years' should therefore be more clearly defined (page 61).