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West Aust
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magpie
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mercury
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monitoring
fish
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# PESTICIDES AND OTHER CONTAMINANTS OF FISH AND WILDLIFE.

## NOTES FOR DISCUSSION.

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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 84,000 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.

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 $As_2O_3$) 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.