Environment Agency

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Health and ecotoxicology of otters: summary of four studies from 1988-2003

Science Report SC010064/SR2

SCHO0307BMKM-E-P

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It's our job to make sure that air, land and water are looked after by everyone in today's society, so that tomorrow's generations inherit a cleaner, healthier world.

Our work includes tackling flooding and pollution incidents, reducing industry's impacts on the environment, cleaning up rivers, coastal waters and contaminated land, and improving wildlife habitats.

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- **Funding science,** by supporting programmes, projects and people in response to long-term strategic needs, medium-term policy priorities and shorter-term operational requirements;
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- **Carrying out science**, by undertaking research – either by contracting it out to research organisations and consultancies or by doing it ourselves;
- **Delivering information, advice, tools and techniques,** by making appropriate products available to our policy and operations staff.

Steve Killeen

Head of Science

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1. Introduction

This report summarises the findings of a long-term study of otters (*Lutra lutra*) in England and Wales. A total of 1027 dead otters were examined between 1988 and 2003. Most were killed on roads, and were submitted to the Environment Agency by the general public, often through the county Wildlife Trusts. The study looked at the overall health of otters, factors affecting their survival and the impact of certain chemicals on otter populations.

The full reports for these studies are as follows:

SIMPSON, V.R., 1998. *A post mortem study of otters (*Lutra lutra*) found dead in South West England.* Bristol: Environment Agency, Technical Report W148.

BRADSHAW, A.V. and SLATER, F.M., 2003. A Postmortem Study of Otters (Lutra lutra) in England and Wales. Bristol: Environment Agency, Technical Report W1-019/TR.

SIMPSON, V.R., 2007. *The health status of otters in Southern and South West England*, 1996-2003. Bristol: Environment Agency, Science Report SC010064/SR1.

CHADWICK, E.A., 2007. *A post mortem study of otters in England and Wales 1992-2003.* Bristol: Environment Agency, Science Report SC010065/SR.

2. Background

Otter populations in the UK suffered a dramatic decline from the mid 1950's to the early 1980's. Evidence suggests that this decline was due to the impacts of toxic chemicals, particularly organochlorine pesticides (OCs) and polychlorinated biphenyls (PCBs). In the UK otters had become extinct over most of lowland England and Wales by 1980, with remnant populations remaining in Devon, Cornwall and West Wales. This decline was mirrored across Western Europe. As a result, otters became the focus of major conservation efforts across their range.

As the top predator in the freshwater environment, otters are an important indicator of the health of rivers and lakes across Europe. As mammals, they give an insight into the potential effects of man-made chemicals on people. The main purpose of this study was to:

- investigate the overall health of otters;
- establish the levels of man-made chemicals in wild otters;
- assess whether these chemicals were having a detrimental effect on individual otters or on their populations;
- investigate factors affecting otter survival;
- identify conservation measures to ensure the recovery and long-term viability of otters in the UK.

3. Results

3.1 Number of otters examined

A total of 1027 otters were examined in the study period. Most of these were adults, of which 62 per cent were male and 38 per cent female. Among the juvenile animals submitted, the sex ratio was 1:1. The number of otters submitted has increased year on year. Currently, approximately 140 otters are examined each year. Most are found in winter, the number of otters killed on roads is strongly correlated to the hours of darkness, with the highest numbers submitted between October and March. There is a peak in the number of otters killed in February.

3.2 Cause of death

The majority of otters died as the result of road traffic accidents; over 83% in southern England, and 92% in the rest of England and Wales. In southern England a further 11% died as the result of bite wounds and subsequent infection. Other causes of death included young cubs that had been abandoned and either starved or were killed by dogs; and a small number of otters killed illegally by snares or drowned in fyke nets.

3.3 Size and weight

The majority of otters submitted were in excellent condition. Adult males were larger than females, and the sexes had average lengths of 110 cm and 105 cm respectively. On average males weighed 8kg compared with 6 kg for females. A few, very large males were recorded weighing over 11.3 kg, up to a maximum of 12 kg. These came from South West England and East Anglia.

A condition index (CI) was calculated for the majority of otters. This gives a measure of their overall health. Though males are larger, they were in slighter poorer condition than females. The average male condition index was between 1.03 and 1.07, compared with 1.04 to 1.14 for females.

Otters suffering from infection, ill health or starvation had a markedly lower condition index.

3.4 Health issues

Wild otters are generally healthy. However, these studies give a remarkable insight into some aspects of their health and lifestyle.

3.4.1 Renal calculi

Up to one third of older, adult animals suffered from renal calculi (kidney stones). The incidence varied widely through the 15 years of the study and there is some indication that they occur more commonly in animals living in calcareous waters. The kidney stones did not appear to have a detrimental effect on the individuals concerned.

3.4.2 Bite wounds

The number of animals submitted with bite wounds increased significantly over time. At present over 50 per cent of the otters from South West England show obvious bite wounds. It appears that these are the result of fighting with other otters (intraspecific aggression) and occur in both males and females. In Wales the incidence is lower with 20 per cent of otters examined in recent years showing bite wounds. This finding is significant for two reasons:

- Social interactions are important within otter society. This suggests that otters defend their home range (and possibly food resources) from other otters.
- The increase in fighting injuries may be density dependent and has only become apparent as otter numbers (and competition for resources) have increased. It suggests that otter populations may be approaching carrying capacity in some areas.

Previous work has suggested that bite wounds were a result of encounters with dogs. This study shows that most result from fighting with other otters and a smaller number from encounters with mink.

3.4.3 Fractured or missing teeth

Dental injuries were relatively common in the animals submitted, with up to 27 per cent of males from Southern and South West England having damaged incisors. A small number (14 per cent of adults) had injuries to the canines or molars. These were significant as they often became infected, leading ultimately to the otter's death.

3.4.4 Respiratory tract infections

Small lesions are relatively common in the lungs of otters. Most are due to infection by a fungus, leading to a condition called adiaspiromycosis that is rarely fatal. Occasionally lung lesions similar to those of tuberculosis (TB) were seen. In these cases samples were taken, but proved negative for TB.

A few otters showed severe lung infections such as pleurisy. These animals were already weak prior to being run over and the infections would ultimately have resulted in their death.

3.4.5 Bile flukes

Harmful parasitic infections were rare in the otters examined. However, there was one interesting exception. A number of otters showed abnormalities in the gall bladder. Subsequent investigations revealed that this was due to the presence of a bile fluke, which is new to the UK. Currently this infection is confined to otters from Somerset, Dorset and Hampshire, and is believed to have arrived in fish imported from Eastern Europe. Investigations are continuing.

3.5 Reproductive status

Between 30 per cent (Wales) and 40 per cent (South West) of female otters examined showed evidence of breeding, and were either pregnant or lactating. Most had evidence of having between one and three foetuses or cubs. Pregnancy can occur at any time of year.

A few cubs were submitted as part of the study. Most were ill and starving, having been orphaned or abandoned. They were taken in by the RSPCA (Royal Society for the Prevention of Cruelty to Animals) and subsequently died or were euthanased.

3.6 Ecotoxicology

Liver samples from the otters were analysed for a range of man-made chemicals at the Environment Agency's laboratories in Devon. There are few similar studies carried out in the UK, and this is the only such work on mammals carried out by the Environment Agency.

The analysis focussed on organochlorines (OCs) and their derivatives, organophosphate (OPs), polychlorinated biphenyls (PCBs), and heavy metals, many of which have been implicated in the decline of otters in Europe. One of the most important aspects of this study was to examine not only the level of pollutant loadings, but also whether these were linked to any physiological effects on the animals. The key findings are described below.

3.6.1 Organochlorines (OCs)

The most commonly occurring OCs in otters were dieldrin and the para para (pp) isomers of DDE and TDE (both derivatives of DDT). The results varied between regions. Otters from South West and Southern England showed a highly significant decline in the levels of ppDDE, ppTDE and dieldrin over time. This correlates with the withdrawal of these chemicals from 1962 onwards, leading to a complete ban by 1989. However no significant decline was observed in ppTDE and dieldrin in otters from Wales, and in certain parts of England, while ppDDE declined in male otters, but not in females.

The impacts of OCs on wildlife are well documented. It is now known that they interfere with vitamin A metabolism, which, in extreme cases, leads to a

number of conditions, including reproductive abnormalities. Vitamin A levels were investigated in 100 otters from South West and Southern England. These were analysed between 1996 and 2000. Almost half had vitamin A levels below the normal threshold for domestic animals and 14 were critically low.

Although low vitamin A levels were recorded from otters with relatively high OC levels the correlation was not statistically significant. Importantly the vitamin A level in otters has increased over time. Overall there is considerable variation in the vitamin A levels between individual otters, with significant differences between age classes and sexes.

Two other collaborative studies were carried out looking at the impacts of OCs in otters from South West and Southern England.

Firstly, a study of the incidence of retinal dysplasia (distorted retina in the eye) found that 30per cent of a sample of otters collected between 1996 and 1999 were affected. Retinal hyperplasia is a developmental abnormality due to low vitamin A levels. The concentration of dieldrin in otters showing this eye abnormality was over three times higher than in otters with normal eyes.

Secondly, a small study examined the length of the penis bones (baculum) in juvenile male otters in relation to the levels of OCs in the animals. This found a significant negative correlation between the length of the baculum and both the concentration of dieldrin and the sum of DDT derivatives.

The weight of the otters' thyroid glands was positively correlated with the levels of ppDDE in their livers, and with the overall size of each animal. Significantly the size of otter thyroid glands has decreased over the study period in line with the decline in DDT.

3.6.2 Organophosphates

No significant levels were detected in otters

3.6.3 Hexachlorobenzene (HCB)

HCB was found in more than 93 per cent of the samples taken, and has not declined over time.

3.6.4 Polychlorinated biphenyls (PCBs)

The commonly occurring congeners were 105, 118, 128, 138, 153, 156, 170, 180 and 187. PCBs occurred in over 95 per cent of samples taken since 2001. The concentration of PCBs in otters has not declined during the period of this study.

3.6.5 Heavy metals

The levels of heavy metals recorded were not significant with one exception, an otter from Hampshire, with high arsenic levels. This remains unexplained.

A collaborative study looked at lead levels in otters, using the rib bones from 300 otters held in the archive. This showed a significant decline in lead levels between 1992 and 2004.

3.6.6 Distribution of chemicals

The distribution of pollutants in otters was analysed by region. The highest levels of organochlorine pesticides occurred in the Midlands. Other rankings varied between different chemicals, however PCBs and HCB were highest in the North East and North West regions.

3.6.7 Pollutant residues in otters

Overall, pollutant concentrations are higher in adult males than in adult females. This almost certainly results from the excretion of these compounds during pregnancy and lactation. Juvenile otters had high levels of pollutants, presumably as a consequence of the same mechanism. Evidence suggests that OCs and PCBs accumulate with age in males, while in females an initial increase was followed by a decline in concentration following sexual maturity.

4. Associated studies

These studies have provided material for several other collaborative projects:

- DNA studies at Cardiff and Exeter Universities;
- dietary analysis at Swansea University and the Environment Agency fish laboratory at Brampton;
- a study of endo and ecto parasites at Swansea University;
- morphometric studies in association with Swansea University;
- chemical analysis for PBDEs (brominated flame retardants) at Exeter and Liverpool Universities;
- comparisons with long-term datasets on pollutant concentrations in birds with the Centre for Ecology and Hydrology;
- routine screening for infectious disease in wildlife in association with the Central Vet Laboratory;
- a study of *Helicobacter* in otters and humans with Liverpool University and the Health Protection Agency;
- screening for Aleutian disease and canine distemper virus with Glasgow Veterinary School;
- investigation of techniques to age otters using the cementum in teeth at Cardiff University.

The archive of otter tissues derived from this project provides a valuable resource for such work.

5. Outstanding issues

5.1 Age

One of the problematic areas of this project is the inability to age otters accurately. Several trials have been undertaken looking at the growth rings in the animals' teeth, but these have proved unreliable. A further trial is planned.

Ageing is important in terms of the population profile and in understanding how the pollutant burden may accumulate in otters over time.

5.2 Other chemicals

A number of new products that are widely used in the environment are suspected of causing adverse effects on wildlife. We are doing preliminary work to find out if these chemicals can be monitored as part of the otter post mortem project.

5.3 Endocrine disruption

This study identified some physiological impacts on otters as a consequence of exposure to OCs, but the range of environmental variation found in a wild population obscures the picture. The project illustrates some of the difficulties in obtaining objective information about the impacts of man-made chemicals on mammals.

6. Conservation measures

This study has shed light on a number of aspects of otter ecology, which are directly relevant to conservation work in the Environment Agency.

Road traffic accidents are a significant cause of otter mortality. The major concern is the number of breeding females killed. Results from the national otter surveys show that otters are expanding their range and it is unlikely that the numbers killed are having a significant impact on the population as a whole. However problems are apparent where several otters are run over at specific sites. These accident hotspots need to be identified and remedial action taken. A number of successful mitigation schemes have been carried out and the Environment Agency is working with relevant highways authorities to continue this programme of work.

If OCs were the cause of the crash in otter populations in the latter half of the twentieth century, indications that OC levels are declining in the environment may explain the recovery and continued expansion of the otter. These studies have not identified any other man-made chemicals that currently pose a threat to otters, but the number of chemicals examined is comparatively small.

Routine screening of the population has established that otters are healthy and do not carry infectious disease of significance to man. The potential effects of the introduced bile fluke gives cause for concern and further investigations are being carried out.

7. Future work

The findings of this project have assisted the Environment Agency's conservation work on otters. It has also given a valuable insight into the effects of man-made chemicals on wild animal populations. The otter post mortem project is continuing as part of our core environmental monitoring programme. This recognises the importance of otters as a key indicator of the health of our waters and wetlands.

Lyn Jenkins
March 2007

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Your environment is the air you breathe, the water you drink and the ground you walk on. Working with business, Government and society as a whole, we are making your environment cleaner and healthier.

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