PESTICIDE POISONING OF ANIMALS 2001

A REPORT OF INVESTIGATIONS IN SCOTLAND

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SUMMARY

The Wildlife Incident Investigation Scheme in Scotland investigates deaths of wildlife, including beneficial insects, pets and livestock, where there is strong evidence to indicate that pesticide poisoning may be involved.

The scheme, together with sister schemes throughout the United Kingdom, provides a means of post-registration surveillance of pesticide use, so that registration may be revised if necessary. They also provide a measure of the success of the pesticide registration process, and help in the verification and improvement of the risk assessments made in the registration of compounds. Incidents of approved use and of misuse can highlight problems with the approval conditions or the label instructions for a pesticide, and can provide valuable feedback into the regulatory process.

The scheme in Scotland also furnishes evidence that can be used by SEERAD, or by the police, to enforce legislation on the use of pesticides, and in the protection of food, the environment, and animals.

There were 127 suspected incidents registered for investigation by the scheme in 2001. The causes were determined in 60 incidents, of which 35 (28% of those investigated) involved pesticide poisoning or exposure to pesticides. Only one incident, involving a bromadiolone formulation, was attributed to approved use of a pesticide. A single incident, involving brodifacoum, was attributed to the misuse of a rodenticide formulation. The reduced number of incidents investigated in 2001 appears to be a consequence of measures restricting access to agricultural land during the outbreak of Foot and Mouth disease.

Deliberate abuse of pesticides was identified in 25 incidents in 2001 compared to 29 in 2000, and 18 in 1999. This represents 71% of pesticide incidents in 2001 compared to 51% in 2000, and 44% in 1999. These data tend to confirm the view that there is little evidence to suggest a long-term decline in the extent of abuse. Carbofuran formulations were the most actively abused pesticides.

A further 8 incidents were attributed to unspecified use of a pesticide, where there was insufficient information available to positively identify the source of the poison. Each of them involved exposure to an anticoagulant rodenticide. No incidents resulted from exposure to pesticides formulated as veterinary medicines.

Only eight agricultural chemicals were identified in the pesticide poisoning incidents, compared to eighteen in 2000.

INTRODUCTION

1. In the United Kingdom the impact of all pesticide uses on wildlife and other animals, including beneficial insects such as honeybees, is assessed before approval is granted by the regulatory body. Where it is thought that an unacceptable risk would arise, restrictions on use may be imposed in the conditions of approval under the Control of Pesticides Regulations (COPR) 1986 (as amended) or the Plant Protection Products Regulations (1995), in order to protect wildlife and domestic animals.

2. The Scottish Wildlife Incident Investigation Scheme (WIIS) is one of four schemes, operating in the United Kingdom, which investigate possible pesticide poisoning of animals. The scheme in Scotland is operated by the Scottish Agricultural Science Agency (SASA) on behalf of the Environment and Rural Affairs Department of the Scottish Executive (SEERAD). The procedures for incident investigation are described in Appendix I.

3. Incidents confirmed as involving pesticides are assigned to one of four categories:

- **Approved use** of the product, according to the specified conditions of use;
- **Misuse** of a product, by careless, accidental or willful failure to adhere to the correct practice;
- **Abuse** of a pesticide, in the form of deliberate, illegal attempts to poison animals;
- **Unspecified use**, where the cause could not be assigned to one of the above categories.

There is also a category of Veterinary use, where subsequent investigation identifies the involvement of a pesticide formulated as a veterinary medicine. Such cases are investigated incidentally rather than deliberately, and may include abuse, misuse, approved use, or unspecified use of the relevant compounds. Incidents suspected of involving veterinary medicines should be reported to the Veterinary Medicines Directorate (Tel. 01923-338427).

4. The results of investigations are reported to the Environmental Panel of the Advisory Committee on Pesticides (ACP). The information provided may result in a re-evaluation of the approvals previously granted to products, or may affect the progress to full commercial use of products currently under provisional approval. Information from incidents assists in the validation and improvement of the risk assessment procedures used by the regulatory body for new and existing compounds.

5. The majority of this post-registration surveillance activity is funded jointly by the agricultural and non-agricultural sectors of the pesticide industry, under the Food and Environment Protection Act 1985 (FEPA). In cases where there is evidence to indicate misuse or deliberate abuse of a pesticide, the results of investigations may also result in legal enforcement. Under FEPA and COPR, all aspects of pesticide advertisement, sale, supply, storage and use are fully regulated. If investigations reveal contravention of this Act, or other legislation such as the Wildlife and Countryside Act

1981, then prosecution or other forms of enforcement may ensue. All activities carried out to enforce the legislation in Scotland are funded by SEERAD.

6. SEERAD is a partner in the Campaign against the Illegal Poisoning of Animals led by DEFRA. The freephone number (0800 321600) is routed to SASA and provides ready access for incident notification. To prevent large numbers of dead animals being submitted and analysed, with the consequential impact on resources and finances, strict criteria are applied to potential incidents prior to acceptance. Incidents are only accepted where the use of pesticides may be implicated. Incidents are rejected for further analysis where they obviously involve trauma or disease. Unless there are special circumstances, substantial delays in the notification of incidents or the unavailability of bodies or baits may also lead to rejection.

INCIDENTS IN 2001

NUMBER OF INCIDENTS IN 2001

7. A total of 134 suspected poisoning incidents were notified to SASA in 2001 (177 in 2000). Seven of these were rejected for investigation because the acceptance criteria were not met or because of post mortem evidence, leaving 127 incidents registered for onward investigation. Although restrictions on access to land following the outbreak of Foot And Mouth disease led to a reduction in the number of submissions made to the scheme, the extent of the reduction cannot be quantified.

8. The cause of death or illness (including pesticides and non-agricultural chemicals, disease, starvation and trauma) was established in 60 incidents (47% of those registered). Pesticides were identified in 35 of these incidents (28% of those registered). In other incidents, either no residues were detected, or investigations were terminated because of insufficient information or lack of suitable tissue samples.

9. One incident (3%) was attributed to the approved use of the pesticide involved, 1 (3%) involved an element of misuse, 25 (71%) were associated with abuse and the remaining 8 resulted from some kind of unspecified use (Figures 1,2). A breakdown of incidents by animal category is shown in Table 1. A listing of the pesticides involved, and other causes of death, is presented in Table 2.

Table 1: Number of incidents investigated in 2001

	Incidents Investigated	Pesticide poisoning incidents	Other cause of death found
Vertebrate wildlife	87	30 (34%)	23 (26%)
Livestock	2	0	0
Companion animals	30	4 (13%)	2 (7%)
Beneficial insects	2	0	0
Suspected baits and suspicious substances	6	1 (17%)	not applicable
TOTAL	**127**	**35 (28%)**	**25 (20%)**

Table 2: Number of incidents involving individual pesticides in 2001 and species and/or bait involved.

Organochlorines		
DDE	2	sparrowhawk
dieldrin	2	sparrowhawk
Carbamates		
carbofuran	17	bait, buzzard, cat, crow, golden eagle, magpie, pigeon, red kite
Rodenticides		
brodifacoum	2	buzzard, dog
bromadiolone	11	barn owl, buzzard, dog, duck, pine marten, red kite, tawny owl
difenacoum	5	buzzard, pine marten, red kite
Other compounds		
alphachloralose	7	buzzard, cat, red kite, powder
strychnine	1	bait

- two incidents involved DDE and dieldrin (conclusions unknown and trauma)
- one incident involved carbofuran and difenacoum
- one incident involved bromadiolone and chloralose
- three incidents involved bromadiolone and carbofuran
- one incident involved brodifacoum and difenacoum
- one incident involved bromadiolone, difenacoum and chloralose

Cause of death other than pesticides

disease	6
starvation	7
trauma	12
unknown	60
not applicable	5

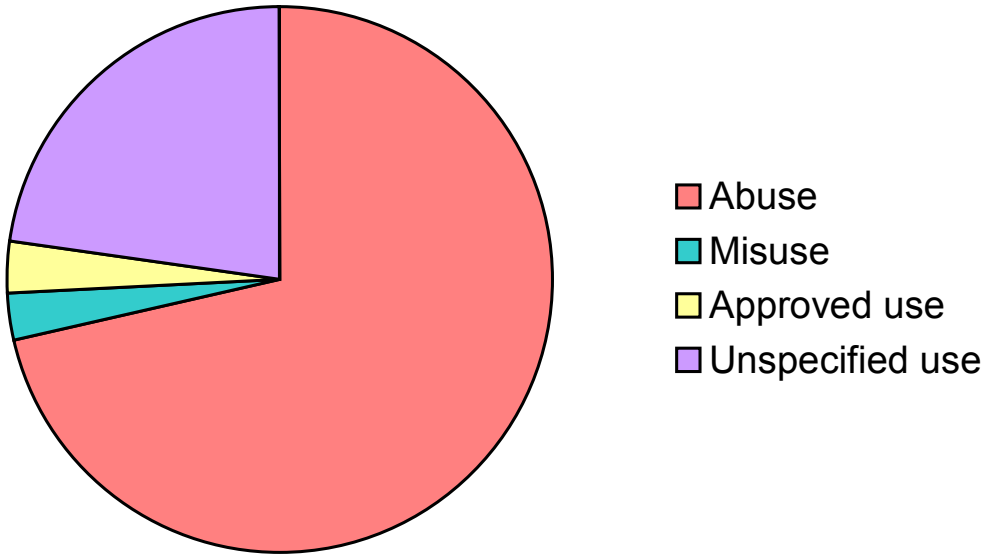

Figure 1. Pesticide Incidents in Scotland 2001

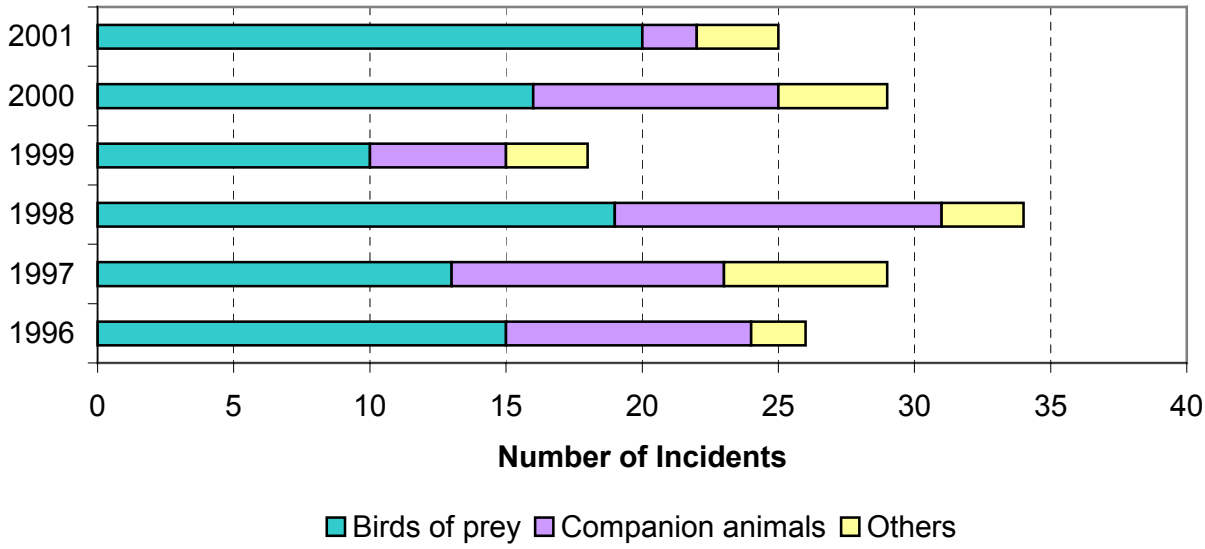

Figure 2. Abuse of pesticides in Scotland

VERTEBRATE WILDLIFE: MAMMALS

10. A total of 8 incidents involving wild mammals were investigated. The cause of death was established in two incidents, with pesticide involvement being confirmed in one of these (Table 3).

Badgers

11. A single incident was reported. Trauma was thought to be the likely cause of death however liver tissue from the animal was analysed for the presence of rodenticides. No residues were detected.

Bats

12. No cause of death was found in an incident involving a number of pipistrelle bats that were found dead in an old railway building undergoing renovation in Dumfries.

Table 3: Number of incidents involving wild mammals in 2001

	Number of incidents investigated	*Number (%) in which pesticide poisoning was identified*	*Number (%) in which another cause of death was identified*
Badger	1	0	1 (100%)
Bat	1	0	0
Fox	2	0	0
Hedgehog	2	0	0
Mole	1	0	0
Pine marten	1	1 (100%)	0
TOTAL	**8**	**1 (12%)**	**1 (12%)**

Foxes

13. Two incidents involving foxes were reported during the period. In one case the animal was recovered during a field investigation following the poisoning of a red kite with carbofuran near Castle Douglas, Dumfries & Galloway. It was thought to be a possible victim of deliberate abuse, however no analytical evidence was obtained to support this suspicion. The liver tissues from both foxes were analysed for the presence of rodenticides, as residues of this type of compound have been identified at a relatively high frequency in this species. No residues were detected.

Pine marten

14. Low, sub-lethal, residues of bromadiolone and difenacoum were confirmed in liver tissue from one of four pine marten carcases that had been recovered from a taxidermist's premises in Tayside, along with a buzzard that was confirmed to have died as a result of pesticide poisoning.

Other Mammals

15. Incidents involving hedgehogs (2) and a mole were notified during the year. In one of the incidents a hedgehog was submitted after the carcase had been recovered from an area in Dumfries where a red kite had been poisoned with carbofuran. There was no analytical evidence to confirm that it was the victim of pesticide abuse. The cause of death was not established in either of the incidents.

VERTEBRATE WILDLIFE: BIRDS

Birds of Prey (including owls)

16. A total of 65 incidents involving birds of prey were notified. The cause of death was established in 44 (68%) incidents; with pesticide poisoning accounting for 27 (42%) of these (Table 4).

Table 4: Number of incidents involving wild birds in 2001

	Number of incidents investigated	*Number (%) in which pesticide poisoning was identified*	*Number (%) in which another cause of death was identified*
Birds of prey including owls	65	27 (42%)	17 (26%)
Wildfowl and waterbirds	5	1 (25%)	0
Gulls and waders	0	0	0
Pigeons and doves	5	1 (20%)	0
Corvids	6	2 (33%)	1 (17%)
Game birds	1	0	1 (100%)
Other birds	3	0	3 (100%)
TOTAL	**85 ***	**31 * (36%)**	**22 (26%)**

***** Three incidents involved birds from more than one category and three incidents involved birds and mammals. In two incidents animals from different categories died as a result of pesticide poisoning.

Buzzards

17. Common buzzards were involved in 33 incidents in 2001. The cause of death was established in 22 of the incidents, with 13 being attributed to pesticide poisoning. Deliberate abuse of pesticides accounted for 9 of these incidents; the chemicals involved were chloralose (5) and carbofuran (4). In 2 of these cases sub-lethal residues of bromadiolone and difenacoum were also detected in the liver tissues from the poisoned birds. The 4 remaining pesticide incidents were associated with the unspecified use of brodifacoum (1), bromadiolone (2) and difenacoum (2). In one case from Grampian, the residue ($0.2 mgkg^{-1}$) of bromadiolone in liver tissue was within the lethal range but no positive evidence of haemorrhaging in the carcase had been noted at the post mortem examination. The other residues were all in the sub-lethal range, with one buzzard from South Uist in the Western Isles having been exposed to both brodifacoum and difenacoum.

Eagles

18. Golden eagle deaths were notified in 4 incidents. Pesticide poisoning was established as the cause of death in only 1 incident. A hillwalker found a decomposed eagle carcase in Highland region in August. Analytical investigation confirmed that the death was associated with the abuse of carbofuran. Starvation was established as the cause of death in one of the other incidents. No cause of death was established in the remaining 2 incidents.

Red Kites

19. Pesticide poisoning was involved in the death of 11 out of the 15 red kite incidents notified in 2001. Deliberate abuse of carbofuran was confirmed in 9 incidents, 5 from Highland, 2 from Dumfries & Galloway, and one each from Border and Central regions. Sub-lethal residues of bromadiolone (3) and difenacoum (1) were also detected in liver tissues from 4 of these poisoned birds. The abuse of chloralose caused the death of a red kite in Tayside in April. The remaining pesticide incident involved the sub-lethal exposure to a rodenticide, resulting from an unspecified use of difenacoum. No cause of death was established in the other four incidents.

Other Raptor Species

20. In 2001 four incidents involving sparrowhawks were notified to the scheme. In 3 incidents the cause of death was established as resulting from trauma, no cause of death was established for the remaining case.

21. Only one incident involving a peregrine falcon was reported during 2001. No cause of death was established.

22. Eight incidents involving owls (4 barn owls and 4 tawny owls) were submitted for examination; unspecified use of bromadiolone was responsible for the death of one barn owl, and for the sub-lethal exposure of one tawny owl. In the case of the barn owl, there was post mortem evidence of altered blood in the intestines. Two barn owls and one tawny owl died as a result of trauma.

23. Two incidents involving kestrels were submitted as potential pesticide poisoning cases. No evidence of exposure to pesticides was detected; starvation was attributed as the cause of death in one of these incidents.

Wildfowl and Waterbirds

24. In 2001 there were five incidents involving wildfowl and waterbirds. The cause of death was associated with pesticide poisoning in one incident. Ducks were found to have died from bromadiolone poisoning around a pond area in Tayside where "Slaymor", a rodenticide formulation containing bromadiolone, was being used to control rats. No cause of death was determined for a heron submitted as part of the same incident. The incident was classified as arising from approved use of the rodenticide product. In the other four incidents involving a goose, a swan, a duck and a heron no cause of death was established.

Pigeons

25. Pigeon deaths were notified in five incidents; three involved racing pigeons and the other 2 involved feral pigeons. Carbofuran poisoning was confirmed as the cause of death of 2 feral pigeons in a residential area of Glasgow in September. A number of birds, including a magpie, had died from carbofuran poisoning in an earlier incident from the same area during July (see paragraph 26). No cause of death was established in the remaining 4 incidents.

Corvids

26. A total of 6 incidents involving crows (3), jackdaws (1), raven (1) and a magpie (1) were notified during 2001. Pesticide poisoning was found to be the cause of death in 2 incidents. The abuse of carbofuran resulted in the death of a magpie, and other birds in Strathclyde, and of a crow and a red kite in Highland. Trauma, associated with gun shot wounds, was established as the cause of death of approximately 20 jackdaws found dead in Grampian. No cause of death was identified in the other incidents.

Game birds

27. One incident involving a partridge was submitted in 2001. Young birds were thought to have been oversprayed with a pesticide formulation containing MCPA. Subsequent information from the submitting laboratory indicated that the birds had a *Salmonella* infection.

Other birds

28. Three incidents involving finches; two greenfinches and one chaffinch were reported during 2001. The finders were all concerned that the birds might have died from pesticide poisoning, however post-mortem examination and associated bacteriology testing revealed that in all three cases death was due to a *Salmonella typhimurium* infection.

LIVESTOCK

29. Only two incidents involving livestock were notified in 2001 (Table 5). No evidence to implicate pesticide poisoning, or any other cause of death, was found in either of the incidents.

Table 5: Number of incidents involving livestock in 2001

	Number of incidents investigated	*Number (%) in which pesticide poisoning was identified*	*Number (%) in which another cause of death was identified*
Cattle	1	0	0
Sheep	1	0	0
TOTAL	**2**	**0**	**0**

COMPANION ANIMALS

30. Thirty of the incidents registered in 2001 involved companion animals (Table 6). The cause of death was established in 6 (20%) of cases, with pesticide poisoning being responsible for 4 (13%) incidents and disease being the cause in the two remaining cases.

Cats

31. In two of the 11 incidents in which cats were involved, the animals were found to have died as a result of pesticide poisoning. Abuse of chloralose in an incident in Tayside accounted for one death. The other incident occurred in Border, and involved the abuse of carbofuran.

Dogs

32. The cause of death was established in four of the 16 incidents involving dogs. An unspecified use of a rodenticide product containing bromadiolone was associated with the death of a farm dog in Lothian and misuse of a brodifacoum formulation resulted in the death of a young foxhound in Tayside. The two remaining incidents were attributed to disease.

Other animals

33. Single incidents involving a ferret, a horse, and two pet rabbits respectively, were reported during 2001. No cause of death was found for any of these incidents.

Table 6: Number of incidents involving companion animals in 2001

	Number of incidents investigated	*Number (%) in which pesticide poisoning was identified*	*Number (%) in which another cause of death was identified*
Cats	11	2 (18%)	0
Dogs	16	2 (12%)	2 (12%)
Ferret	1	0	0
Horse	1	0	0
Rabbit	1	0	0
TOTAL	**30**	**4 (13%)**	**2 (7%)**

BENEFICIAL INSECTS

34. Only two incidents of suspected honeybee poisoning were accepted into the Scheme in 2001 (Table 7). The analytical investigations failed to provide any evidence to implicate pesticide poisoning with either incident. No cause of death was established.

Table 7: Number of incidents involving beneficial insects in Scotland during 2001

Number of incidents reported:	**2**
Number of incidents where pesticides were detected and confirmed:	**0**

SUSPECTED POISONOUS BAITS

35. Six items were submitted for investigation as suspected poisonous baits or related materials during 2001 (Table 1). In each case there were no known animal casualties associated with the alleged bait. A pesticide residue was detected in only one of the incidents. Approximately 8 link sausages were reported to have been adulterated with strychnine and laid near a pheasant release pen, apparently with the intention of poisoning a fox. Fortunately the bait was exposed for a very short time before it was recovered, and there is no evidence that wildlife or companion animals were poisoned.

In the 5 remaining cases the analytical investigations failed to reveal any evidence to substantiate the belief that the items had been prepared as potential poisonous baits.

INCIDENTS WHERE REGULATORY AND/OR ENFORCEMENT ACTION WAS CONSIDERED

APPROVED USE INCIDENTS

36. Information from incidents thought to have arisen from approved use is fed back into the pesticide regulatory process for evaluation[1,2]. If significant concerns are highlighted by post registration monitoring, thorough consideration is given to the need to adjust the approval status or conditions of use of the pesticide in question. If a specific product is identified in this way, then the approval holder is contacted and given the opportunity to comment and provide additional feedback from their experience with the product.

37. Only a single incident investigated during 2001 was attributed to the approved use of the pesticide product involved, compared to 15 in the year 2000. This incident involved the direct poisoning of ducks following ingestion of a rodenticide bait material.

Incident Summary

38. Several ducks and a heron were submitted from a pond area near Forfar in early April. A relatively high mortality rate had occurred in a population (~150) of mostly mallard during the first two months of the year. The owners of the property had observed a green paste material, which dried to a powder, both in the area used by the ducks and on two goose eggs that the owners did not recall placing. There was a history of problems with neighbours and the owners were concerned that malicious poisoning was taking place. Post-mortem examination of the ducks revealed extensive internal haemorrhages, whilst the heron was emaciated and probably died as a result of starvation. Initial field information indicated that a 'Slaymor' rodenticide formulation had been in use for vermin control on the property. The gizzard material from one of the ducks was a dark green /blue colour, which may indicate ingestion of the bait material which carries a blue dye. Bromadiolone, the active ingredient of 'Slaymor' was identified in liver tissues from some of the ducks. The residues (0.34 to 0.38 $mgkg^{-1}$) were consistent with anticoagulant poisoning being the cause of death. A sample of the green paste, probably faecal material from the ducks that had ingested the rodenticide bait, was also shown also to contain bromadiolone (0.42 $mgkg^{-1}$). Field investigation established that tunnel bait boxes, using the wheat-based formulation, were in use on the property. The boxes had baffles to limit movement of the bait material from the central hopper area into the tunnels. The tunnel length was judged to have been insufficient to prevent access by the ducks to any bait that was transferred into the tunnel area. The owners were advised on better bait-box design to meet the prevailing circumstances on their property.

MISUSE INCIDENTS

39. Only one incident was reported in 2001 where the misuse of a pesticide was identified. This involved the death of a foxhound on a farming estate near Cupar Angus at the end of September. One of the owners was a member of a local hunt, and took young hounds to prepare them for the pack. This animal was allowed freedom to roam on the property, prior to its death. A post-mortem examination revealed a massive inter-thoracic haemorrhage, which focused the analytical investigation on anticoagulant rodenticides. A residue (1.2 $mgkg^{-1}$) of brodifacoum, consistent with anticoagulant poisoning being the cause of death, was detected in liver tissue from the dog. A field investigation established that vermin control on the property was contracted out to a pest control company. Relevant records were up to date, and indicated that bromadiolone and brodifacoum formulations were being used to control rats and mice. During an inspection of buildings there was evidence of small bait boxes in use for mice particularly in a stable. An enclosed, lockable box baiter for rats was also present. Another shed being used as a grain store was closed but not locked, a small sticky label attached to the door read 'POISON KEEP OUT'. The shed was three parts full of wheat, and had trays of loose grained based rodenticide bait material and red coloured rodenticide block bait material. Some of the trays were under pallets, but others were unprotected. This was considered to be the most likely source of exposure for the poisoned dog. The pest control firm indicated that they had been assured that the doors to the grain shed in question would be kept locked at all times, however they agreed to take appropriate remedial actions to prevent further access by non-target animals.

ABUSE INCIDENTS

40. The deliberate abuse of pesticides to poison animals has been a perennial problem in Scotland for many years. The victims of such practice may not always be restricted to the intended target species; any animal that finds a bait material attractive and available as a food source can be at risk. Yet again in 2001, the incidents attributable to abuse continued to make up the majority of those confirmed as involving pesticides. The number was 25 (71% of pesticide incidents), and a high proportion involved birds of prey (Figure 2). Relatively few resulted in the deaths of companion animals compared to previous years. In the case of dogs, this may well be related to restrictions on access to land imposed as a consequence of the Foot and Mouth disease outbreak.

41. Only 3 pesticides were identified in abuse incidents in 2001 compared to 7 in 2000. As in recent years carbofuran (17, 68% of abuse incidents) and chloralose (7, 20% of abuse incidents) were the most frequently abused pesticides. Strychnine was the subject of abuse in the single remaining incident.

42. The re-introduction programme for red kite in Scotland was particularly badly hit with mortalities of 10 birds being attributed to pesticide abuse. Data showing the impact of abuse on this species is shown in figure 3. Birds from all three release areas were killed, and it was particularly disappointing that two separate incidents occurred in proximity to the recently established site in Dumfries & Galloway. Nine of the birds died as a result of the abuse of carbofuran, and one from the abuse of chloralose.

43. Buzzards were casualties in 9 incidents, with 4 of these being attributed to the abuse of carbofuran and the remaining 5 being attributed to the abuse of chloralose. The buzzards poisoned with chloralose were all found in Tayside region, except for a single bird poisoned on the Isle of Bute. In the only other two incidents involving chloralose, a cat and a red kite were poisoned in Tayside.

44. Disturbingly, there was clear evidence to demonstrate the abuse of carbofuran in urban locations. Two incidents occurred in the same residential area of Glasgow in July and September respectively. In the first incident, the death of a magpie was confirmed as resulting from poisoning. Other birds including a starling, pigeons and a crow are believe to have died in this incident. Pigeons were the only victims found in the second incident, where bread probably formed the basis of the poisonous bait.

UNSPECIFIED USE INCIDENTS

45. Each year there are always a few confirmed pesticide incidents where, despite detailed field investigations, the source of the compound cannot be definitely established. Animal bodies may be found in locations remote from the point of exposure in circumstances where the onset of toxic symptoms is delayed. In 2001 a total of 8 incidents (23% of all pesticide incidents) fell into this category, all involved exposure to anticoagulant rodenticides.

46. The death of a dog at Loanhead in Midlothian during April was thought to have resulted from anticoagulant poisoning. There was evidence of free blood in the pleural cavity and bleeding into the mediartrium from the post-mortem examination. A residue (1.1 $mgkg^{-1}$) of bromadiolone was identified in liver tissue from the dog. A field investigation revealed that the previously healthy dog had died unexpectedly whilst under the care of the owners daughter. The premises included a stable, where rat control measures had been taken throughout the winter. Further details could not be ascertained because the owner was unwilling to co-operate on her return from holiday. It would seem most likely that the dog gained access to some unprotected rodenticide bait material on the property.

47. The other 7 incidents all involved birds of prey. Residues of bromadiolone detected in the liver tissues of a barn owl from Border and from a buzzard from Grampian were within the potential lethal range. Sub-lethal residues of bromadiolone were detected in 2 buzzards from Grampian and Strathclyde, and in a tawny owl from Tayside. Sub-lethal residues of difenacoum were identified in the livers of a red kite from the Black Isle, and from 2 buzzards from the Western Isles. Traces of brodifacoum were also identified in one of the buzzards from the Western Isles.

SECONDARY POISONING

48. The impact of anticoagulant rodenticides on birds of prey in Scotland was noted in the reports[3,4] for 2000, and the wider impact on non-target animals has been reviewed[5] using data available from the scheme up to the end of 2000. Continued surveillance of residues is important in gaining a fuller understanding of the environmental risks posed by the use of rodenticides, the species monitored acting as potential indicators for other species.

49. Particular concern has focused on the red kite where the relatively small numbers of breeding pairs in the re-introduction programme could be vulnerable. In 2001, there were no incidents where red kite mortality was directly attributed to secondary poisoning. All red kites received by the WIIS schemes are now monitored for the presence of rodenticide residues in liver tissue, and ten samples were available from 15 incidents involving red kites submitted in Scotland. A residue (0.14 $mgkg^{-1}$) of difenacoum was identified in the liver of a bird submitted from the Black Isle in October (see paragraph 19), however no residues were detected in the case of a young bird submitted from the same area in May. The remaining 8 samples were all from birds that had been victims of deliberate abuse of other types of pesticide. In five of these no residues were detected, but residues were detected in a bird from Central Region in April (0.07 $mgkg^{-1}$ difenacoum), a bird from Border Region in September (0.17 $mgkg^{-1}$ bromadiolone), and a bird from Highland Region in September (0.12 $mgkg^{-1}$ bromadiolone). The frequency (50%) for the detection of rodenticide residues in red kites in 2001 was lower than that observed (64.5%) for all birds (31) of this species examined in Scotland in the years 1998 - 2001.

50. Surveillance on 30 buzzards submitted to the scheme during 2001 identified residues in five birds. Bromadiolone was found in a bird from Tayside in June (0.05 $mgkg^{-1}$), in a bird from Grampian in June (0.2 $mgkg^{-1}$), and in a bird from Arran in October (0.09 $mgkg^{-1}$). Difenacoum was found in two birds from South Uist in the Western Isles in December (0.08 and 0.04 $mgkg^{-1}$). A residue (0.03 $mgkg^{-1}$) of brodifacoum was also found in the second buzzard from South Uist, the first identification of this rodenticide in a bird of prey in Scotland. The magnitude of the bromadiolone residue in the bird from Grampian was within the potentially lethal range (see paragraph 17). The overall frequency of detection of rodenticides for buzzards (100) analysed by the WIIS scheme in Scotland is 16.8%. The occurrence of rodenticide residues in red kites and in buzzards is illustrated in figure 4.

51. Residues of rodenticides were also detected in several other non-target animals. A residue of bromadiolone in the potentially lethal range was found in a barn owl from Border Region in April, and a sub-lethal residue of this rodenticide was identified in a tawny owl from Tayside in July. A multiple residue of bromadiolone (0.04 $mgkg^{-1}$) and difenacoum (0.02 $mgkg^{-1}$) was found in the liver of a pine marten.

ENFORCEMENT ACTION

52. Positive enforcement action continues to be a priority as a measure to counteract pesticide abuse. SEERAD officials frequently work in partnership with wildlife liaison officers from the various police forces in Scotland, as well as staff from other organisations. Where possible, cases are referred to the Procurator Fiscal Service for prosecution. In circumstances where there is insufficient evidence to support prosecution, the fact that an investigation has been seen to take place around the locus may act as a deterrent to re-offending. Where poisoning or the risk of poisoning arises from misuse, and enforcement action is not possible or appropriate, those involved receive advice on how to employ better practice.

53. Opportunities to gather evidence to support enforcement action was severely limited for many of the relevant incidents in 2001 because of restrictions on access to land arising from the outbreak of Foot and Mouth disease. Both SEERAD officials and police wildlife liaison officers kept off agricultural properties until the outbreak had been cleared. Only one case was reported to the Procurator Fiscal Service for breaches of the Wildlife and Countryside Act and the Control of Pesticides Regulations. This related to the abuse of strychnine by a retired gamekeeper. The offender admitted using sausages as a bait medium and placing these around dead pheasants and in a feed bin to control a fox that had been killing pheasants in a small wood around some rural dwellings. There was no evidence to indicate any of the bait material had been consumed by animals. The decision by the fiscal service not to proceed with a prosecution may have been influenced by the age of the offender. The investigation into the poisoning of a buzzard with chloralose in Tayside revealed that crow traps on an estate were not being checked. The gamekeeper was charged under the Wildlife and Countryside Act with killing a wild bird and using a crow traps in an inappropriate manner. The SSPCA are pursuing charges in relation to the discovery of the carcase of a poisoned buzzard on a taxidermists premises. A prosecution arising from incidents involving the poisoning of buzzards with carbofuran during 1999 and 2000 was heard at Perth Sheriff Court in November 2001. The defendant was found guilty on charges under the Wildlife and Countryside Act relating to laying poisonous baits, poisoning wild birds, and possession of a substance capable of being used for committing the above offences; and under the Control of Pesticides Regulations for the improper storage of a carbofuran formulation. He was fined a total of £2400.

54. SEERAD Agricultural Staff carried out 20 field investigations during 2001. Many of these were joint operations with the police, and some also involved RSPB Investigation Officers. An investigation by police and SEERAD officials following the chloralose poisoning incident in Tayside resulted in a quantity of chloralose being surrendered for disposal. The police pursued three incident investigations independently, and the SSPCA undertook one investigation relating to pesticide abuse and other offences.

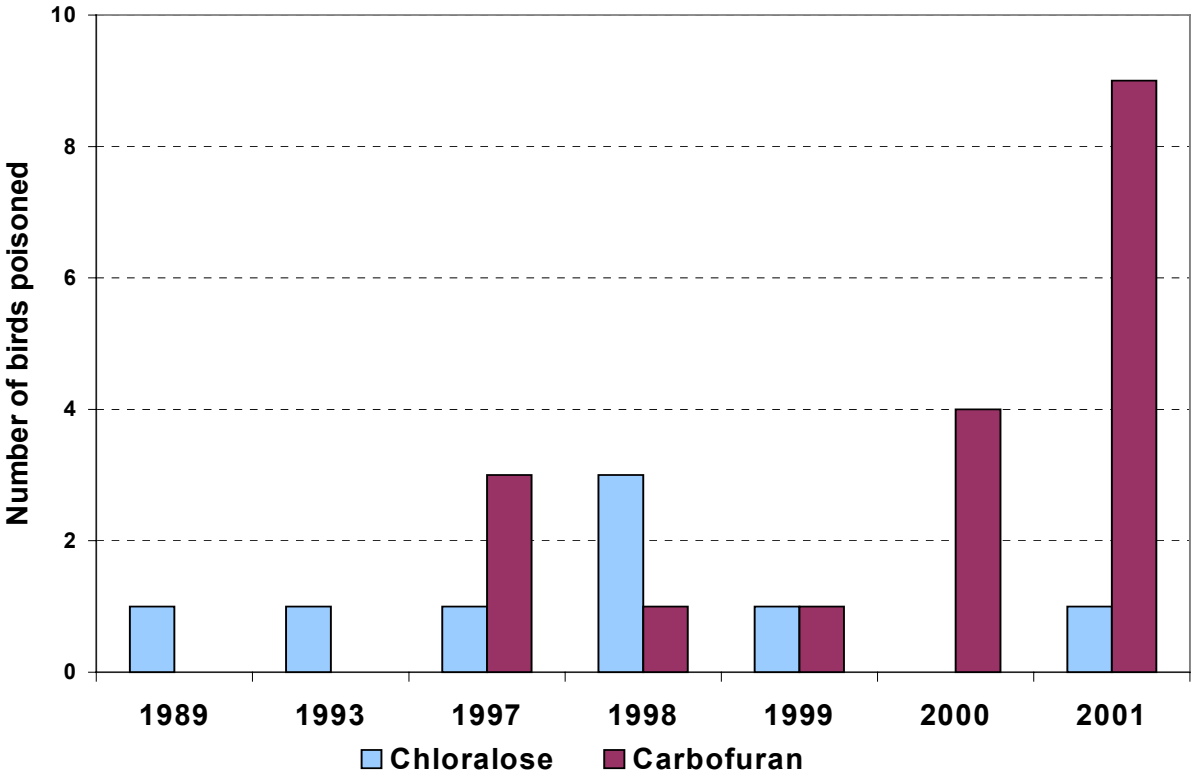

Figure 3. Impact of pesticide abuse on red kites in Scotland

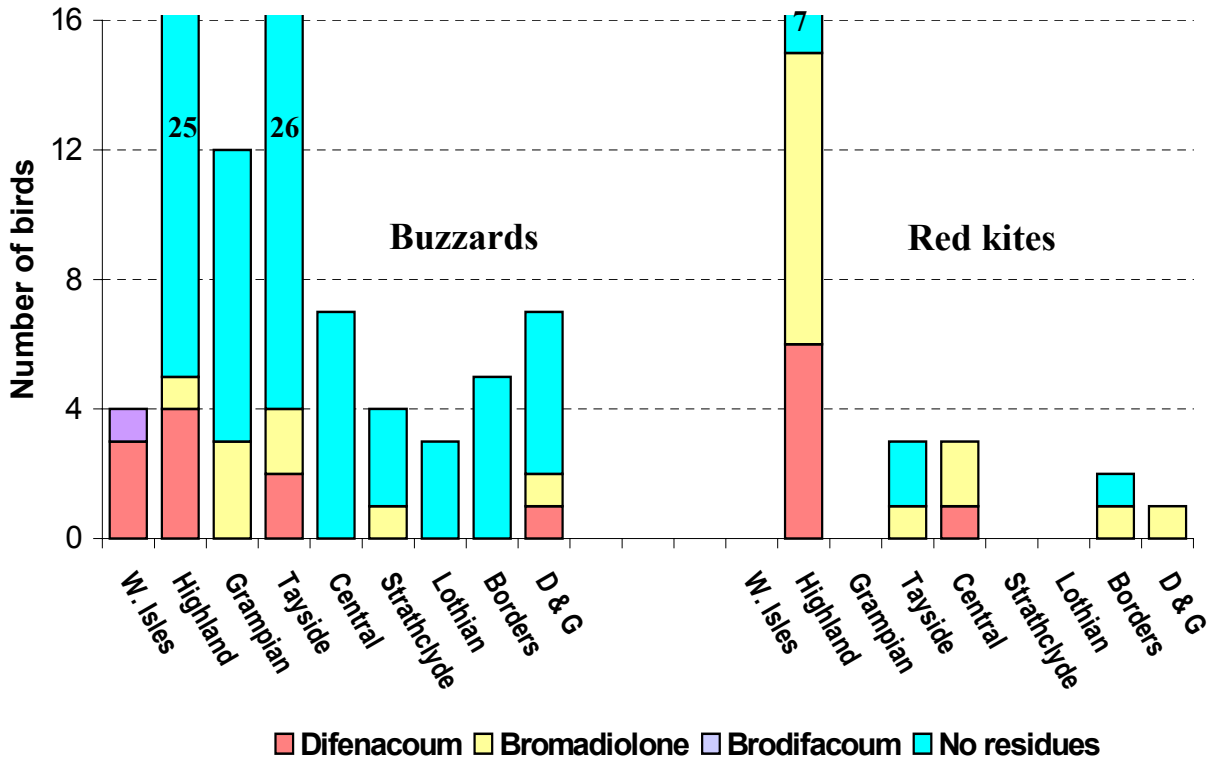

Figure 4. Occurrence of residues of anticoagulant rodenticides in liver tissues of buzzards and of red kites

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APPENDIX 1.

INVESTIGATION PROCEDURES

The investigation of suspected pesticide poisoning incidents relies on a scheme, which allows members of the public and interested organisations to submit carcases, suspected baits or other samples for pesticide analysis. The Wildlife Incident Investigation Scheme is operated in Scotland by the Chemistry Section at SASA, on behalf of SEERAD. Agricultural Staff in the area offices of SEERAD located throughout Scotland, provide support when necessary for field investigations, and also act as an additional point for notification of incidents.

A number of environmental and animal welfare organisations, such as RSPB or SSPCA, play an active role in some incident investigations. These bodies act not only by assisting members of the public to notify incidents, but also by screening out inappropriate cases prior to notification.

The SAC Veterinary Investigation Service acts in partnership with the scheme, in forwarding relevant samples to SASA from potential incidents notified indirectly via its laboratories, and by screening out incidents that are unlikely to involve pesticides. The Lasswade Veterinary Laboratory (VLA) is used to provide specialist pathological support to SASA on wild animals, and also furnishes an additional route into the scheme. The post mortem examinations undertaken by these laboratories may identify disease, trauma, starvation or other causes of death, eliminating the need for expensive analytical investigation.

As well as investigating incidents involving wildlife, the scheme covers suspected poisoning of livestock, companion animals, and honeybees. Incidents may be rejected if they fall outwith the remit of the scheme, or if other acceptance criteria are not met.

SASA makes use of analytical techniques and equipment capable of identifying low levels of pesticides considered to present a possible hazard to vertebrates or beneficial insects. Two multi-residue methods are used for carbamate, organochlorine, organophosphorus, and pyrethroid compounds, and for anticoagulant rodenticides. These are supplemented by compound specific analytical methods for chloralose, metaldehyde, paraquat, strychnine and other compounds. A simpler and more specific method[6,7] for the determination of chloralose in animal tissues based on liquid chromatography in tandem with mass spectrometric detection was introduced during 2001. Wherever possible residues are confirmed using an alternative analytical technique.

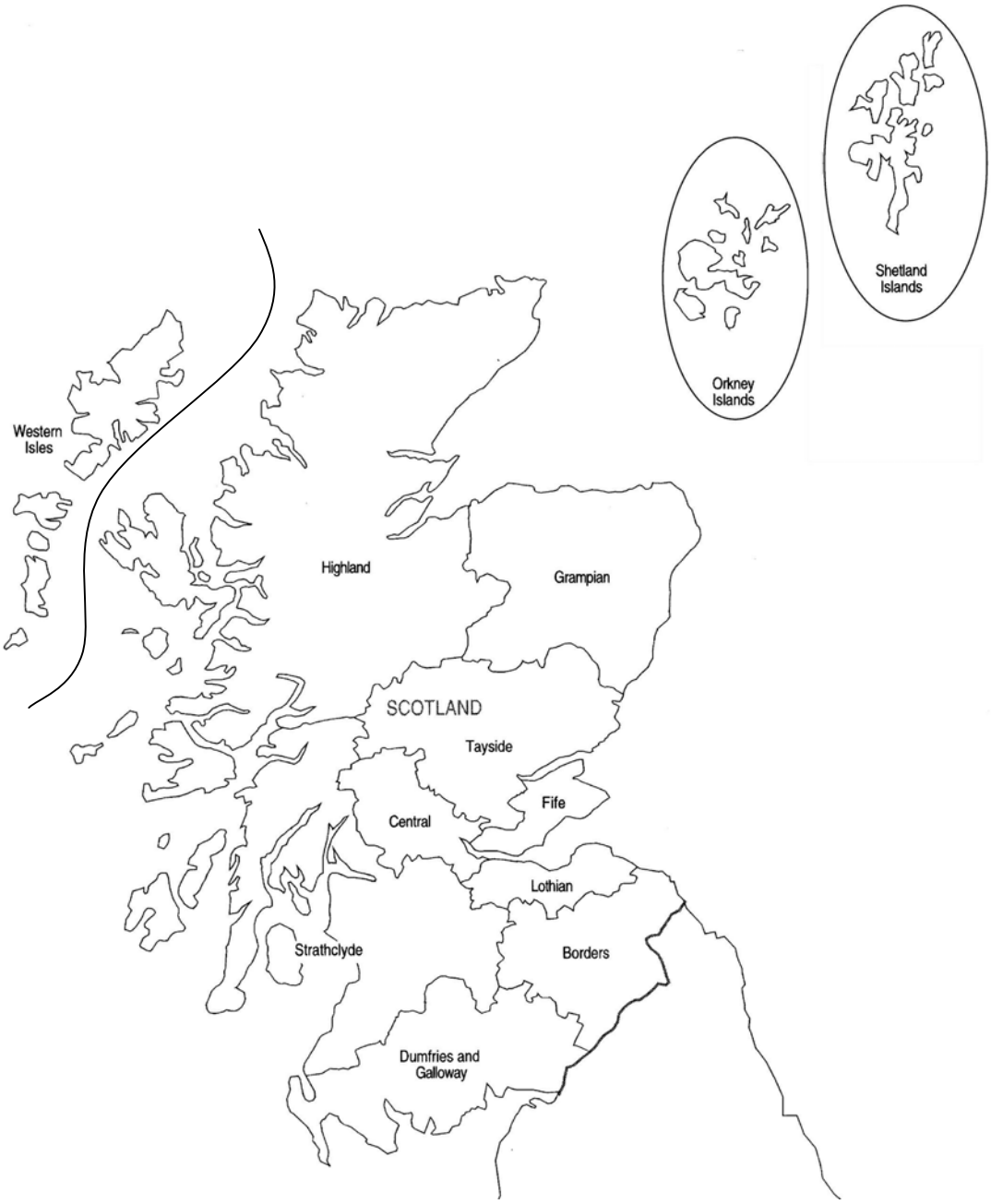
Field investigations are normally only triggered by SASA following the identification of a specific pesticide as the likely cause of poisoning. However field investigations may be initiated following either notification, or after post-mortem examination, if sufficient evidence of pesticide involvement is available.

Analytical results, post-mortem findings, and the field investigation report are collated and interpreted by SASA to assess the probable cause of the incident, and whether any residues detected contributed to the death or illness of the animal involved. Mortality is generally attributed to a pesticide if residues of a chemical or its derivatives are found

at levels considered to represent lethal exposure. In some cases, the presence of residues in association with typical post-mortem findings may be used to determine mortality.

The results of investigations are presented annually as part of an U.K. report published by the Environmental Panel of the Advisory Committee on Pesticides. The regulatory body, Pesticides Safety Directorate, is able to assess relevant incident information for any implications for the approval status of a particular pesticide or family of pesticides. Where legal proceedings are used as part of enforcement action, the evidence gathered by SASA, and by SEERAD Agricultural Staff, is presented in reports to the Procurator Fiscal Service. Police forces are active partners in countering pesticide abuse, and frequently take the lead in investigations and presentation of such cases to the Procurator Fiscal.

APPENDIX 2. REGIONS IN SCOTLAND USED TO CLASSIFY INCIDENTS



APPENDIX 3. PESTICIDE INCIDENTS OCCURRING IN 2001

Incident No.	Date	Location	Species	Pesticide	Conclusion	Enforcement Action	Comments
01020	Feb	Torbreck, Highland	Red Kite	Carbofuran	Abuse	No investigation due to Foot & Mouth outbreak	
01022	Mar	Near Aberfeldy, Tayside	Buzzard	Carbofuran	Abuse	SEERAD, RSPB & Police investigation	
01030	Mar	Lilliesleaf, Border	Barn Owl	Bromadiolone	Unspecified Use		Background residue
01031	Mar	By Forfar, Tayside	Numerous Ducks	Bromadiolone	Approved Use	SEERAD investigation	
01032	Apr	Auchterarder, Tayside	Cat	Chloralose	Abuse	SEERAD investigation	
01033	Apr	Stirling, Central	Red Kite	Carbofuran & Difenacoum	Abuse	SEERAD, RSPB & Police investigation	
01036	Apr	Scaniport, Inverness, Highland	Red Kite and Crow	Carbofuran	Abuse	SEERAD, RSPB & Police investigation	
01037	Apr	Loanhead, Lothian	Dog	Bromadiolone	Unspecified Use	SEERAD investigation	
01039	Apr	Scaniport, Inverness, Highland	Red Kite & Baits (3 pigeon, 1 hare, 1 rabbit)	Carbofuran	Abuse	SEERAD, RSPB & Police investigation	

Incident No.	Date	Location	Species	Pesticide	Conclusion	Enforcement Action	Comments
01045	Apr	Braco, Tayside	Red Kite	Chloralose	Abuse	SEERAD, RSPB & Police investigation	
01054	May	Auchavan, Glenisla, Tayside	Buzzard	Chloralose & Bromadiolone	Abuse	SEERAD & Police investigation	
01061	Mar	Pitlochry, Tayside	Tawny Owl	Bromadiolone	Unspecified Use		
01066	May	Near Garvald, Heriot, Border	Buzzard	Carbofuran	Abuse	Police investigation	
01067	Jun	Glasgow, Strathclyde	Magpie, (Starling, Pigeon and Crow)	Carbofuran	Abuse	Police investigation	Only magpie submitted for analysis
01071	Jul	Coldingham, Border	Cat	Carbofuran	Abuse	SEERAD & Police investigation	
01073	Jul	Scaniport, Inverness, Highland	Red Kite	Carbofuran	Abuse		Related to incidents 01036 and 01039
01081	Unknown	Kintore, Grampian	Buzzard	Bromadiolone	Unspecified Use		
01083	Aug	Carnwath, Strathclyde	Bait	Strychnine	Abuse	SEERAD investigation	Reported to PF but no proceedings taken – possibly due to age of the accused.
01084	Aug	Nairn, Highland	Golden Eagle	Carbofuran	Abuse	SEERAD, Police & RSPB investigation	

Incident No.	Date	Location	Species	Pesticide	Conclusion	Enforcement Action	Comments
01091	Unknown	Near Pitlochry, Tayside	Buzzard & Pine Marten	Chloralose, Bromadiolone & Difenacoum	Abuse	SSPCA investigation	
01093	Sep	Near Stow, Border	Red Kite	Carbofuran & Bromadiolone	Abuse	SEERAD & Police investigation	
01095	Sep	Glasgow, Strathclyde	Pigeon	Carbofuran	Abuse	Police & RSPB investigation	Related to incident 01067
01099	Sep	Perth, Tayside	Buzzard & Crow	Carbofuran	Abuse	SEERAD, Police & RSPB investigation	No residues detected in crow.
01100	Sep	Tomatin, Highland	Red Kite	Carbofuran & Bromadiolone	Abuse	Police & RSPB investigation	
01102	Oct	Coupar Angus, Tayside	Dog	Brodifacoum	Misuse	SEERAD investigation	
01103	Jul	Rothesay, Strathclyde	Buzzard	Chloralose	Abuse	SEERAD investigation	
01104	Sep	Black Isle, Highland	Red Kite	Difenacoum	Unspecified-use		
01107	Oct	Castle Douglas, Dumfries & Galloway	Red Kite	Carbofuran & Bromadiolone	Abuse	SEERAD, Police & RSPB investigation	
01110	Oct	Arran, Strathclyde	Buzzard	Bromadiolone	Unspecified-Use		
01116	Nov	Aberargie, Tayside	Buzzard	Carbofuran	Abuse	Police investigation	

Incident No.	Date	Location	Species	Pesticide	Conclusion	Enforcement Action	Comments
01123	Nov	Dumfries, Dumfries & Galloway	Red Kite	Carbofuran	Abuse	SEERAD, Police & RSPB investigation	
01126	Nov	Ardivachar, South Uist, Western Isles	Buzzard	Difenacoum & Brodifacoum	Unspecified-use		
01127	Dec	Ardivachar, South Uist, Western Isles	Buzzard	Difenacoum	Unspecified-use		
01128	Dec	St Fillans, Tayside	Buzzard	Chloralose	Abuse	SEERAD, Police & RSPB investigation	
01129	Dec	Aberfeldy, Tayside	Buzzard	Chloralose	Abuse	SEERAD, Police & RSPB investigation	