

Further cases of poisoning of wild geese by an organophosphorus winter wheat seed treatment

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Introduction

Winter wheat seed is liable to attack by the wheat bulb fly *Leptohylemyia coarctata* and by various soil borne fungi and thus seed treatments are employed that incorporate both an insecticide and a fungicide. The introduction in the fifties of the persistent chlorinated hydrocarbon insecticides for treating cereal seed led to the deaths of large numbers of grain-eating birds and gave rise to unacceptable environmental contamination. The use of the organochlorine seed treatments was limited in 1961 to autumn sown winter wheat in areas where there was a real danger of wheat bulb fly attack. In 1969, a further review of certain persistent organochlorine pesticides used in Great Britain recommended that the use of aldrin, dieldrin and heptachlor seed treatment to control wheat bulb fly should be continuously assessed with a view to the withdrawal of these compounds as soon as was practicable (HMSO, 1969). Two cereal treatments based on the less persistent organophosphorus pesticides, chlorfenvinphos (2-chloro-1-(2,4-dichlorophenyl)vinyl diethyl phosphate) and carbophenothion (S-(4-chlorophenylthiomethyl) diethyl phosphorothiothionate) have recently come into use and dieldrin has been withdrawn from use as a winter wheat treatment (Anon, 1973).

Bailey *et al.* (1972) investigated an incident in Perthshire in November 1971 that involved the death of about 500 Greylag Geese *Anser anser* and found that the geese had consumed considerable quantities of winter wheat seed treated with carbophenothion and a mercurial fungicide. Biochemical investigations and chemical analysis supported the conclusion that the geese had died from organophosphorus poisoning. We wish to report further cases of geese being poisoned by winter wheat seed treated with carbophenothion. A series of incidents involving Greylag Geese occurred in Angus and Perthshire in November 1974 and a single incident involving Pink-footed Geese *Anser brachyrhynchus* occurred on Humberside in January 1975. The aim of this paper is to describe the field details of the incidents and to discuss the ecological significance of the kills. A full account of the analytical and biochemical investigation of

the casualties is to be published elsewhere (Hamilton *et al.*, 1975).

Field details and background to the incidents

Greylag Goose casualties in Angus and Perthshire, November 1974

Boyd & Ogilvie (1972) reported that the majority of the Greylag Geese that breed in Iceland, winter in Scotland with the largest concentration of over 30,000 birds occurring in Angus and Perthshire. The Greylag Geese return to Scotland during October and maximum numbers occur in Angus and Perthshire in November and again later in the winter. The geese typically roost on inland areas of water and feed on agricultural land within a few miles of the roost. Newton *et al.* (1974) examined the gut contents of a large sample of Greylag Geese shot in east-central Scotland and found that the main food items were grass, barley grains and potato. The bulk of the gut contents consisted of barley grains presumably picked up from the surface of fields after harvest.

Greylag Goose casualties occurred at four sites in November 1974 as shown in Figure 1 and for convenience, the field details are summarized below by reference to the sites.

Lundie, Angus

A report was received on 21st November from a farmer at Lundie, Coupar Angus, Perthshire, that a large number of geese had died at a roosting site on his land. The Divisional Veterinary Officer (DVO) of the Department of Agriculture and Fisheries for Scotland (DAFS) arranged for the site to be visited by a member of his staff and conducted post-mortem examinations. The Veterinary Investigation Officer (VIO) of the East of Scotland College of Agriculture also performed post-mortem examinations and specimens were forwarded to the Veterinary Laboratory, Ministry of Agriculture, Fisheries and Food (MAFF), Lasswade, Midlothian and to the Agricultural Scientific Services, DAFS, East Craigs, Edinburgh for further investigation.

The geese had been found dead in an area of wet, low lying fields that are known to have

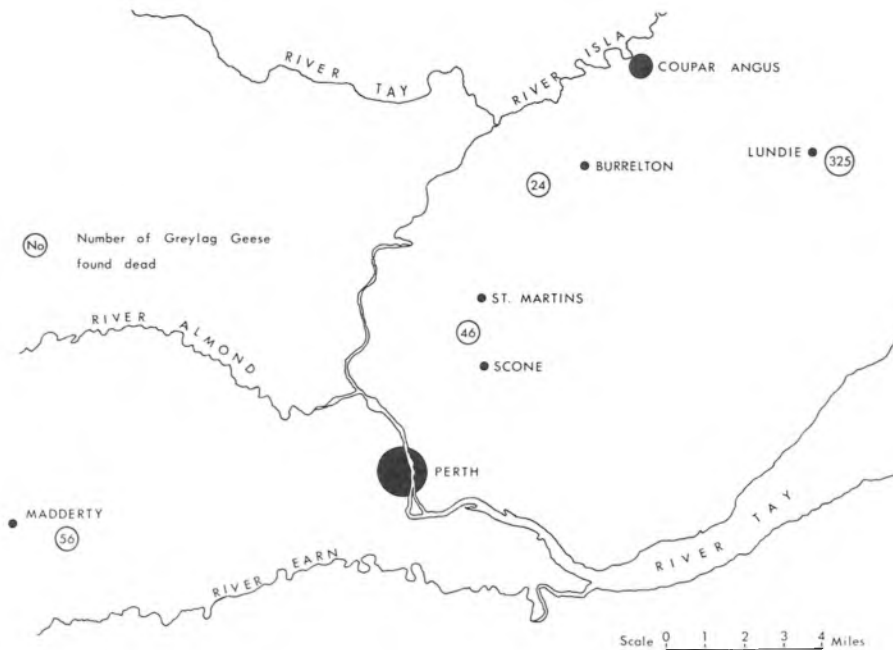


Figure 1. Location of Greylag Goose casualties, Angus and Perthshire, November 1974.

been used as a resting area by a small flock of about 500 Greylags (M. A. Ogilvie pers. com.). An estimate of 300–400 geese having died was supported by a count of the geese using these fields ten days later when a total of 175 birds were present. The incident was investigated by DAFS field staff to obtain relevant information and collect further bodies for examination. At this time, it was suspected that the consumption of treated winter wheat was the probable cause of the incident but frequent and lengthy searches failed to reveal any newly sown fields. Reports indicated that the geese died on 21st and 22nd November. Further reports of goose deaths in the area were received but could not be substantiated.

Scone, Perthshire

A report was received in early December, that dead geese had been seen in fields to the north of Perth Aerodrome and this was confirmed the following day by a Field Officer of DAFS who found 46 dead Greylag Geese. Specimens were forwarded to the Agricultural Scientific Services for analysis. A single Greylag Goose was found dead at St. Martins and although this goose was subsequently shown to have suffered trauma probably by collision with overhead cables,

the specimen was analysed in order to establish whether a pesticide could have contributed to its death. A report of dead geese was received from Burrelton, near Scone where twelve geese had been found dead and a further twelve seriously affected geese were shot. Unfortunately, it was not possible to investigate this report further due to the time that had lapsed before the report was received.

Madderty, Perthshire

In early December a dead Greylag Goose was received from a farmer at Madderty and the accompanying report indicated that several birds had died on the farm. The farm was visited by one of us (GAH) who was informed that 56 birds had died in a field sown with wheat and the bodies had been buried. As the field had been sown with wheat, half of which had been treated with carbophenothion and half with aldrin, several bodies were obtained for analysis to establish which of these insecticides or indeed if both might have caused the deaths. The field in which the dead birds were found appeared to have been sown some time previously because the wheat was well sprouted. The precise dates of sowing and geese deaths were not received until mid-

January. The significance of these dates is discussed later. The farmer considered the sowing had been satisfactory particularly as the soil condition at the time of sowing was favourable. This view was supported by the even emergence and the observation that samples of seed, dug for analysis, had been sown to a depth of about $1\frac{1}{2}$ " (3.5–4.0 cm). The farmer reported that the bills of the dead geese were covered with earth, from which he concluded that they had been digging for the grain. For many years on this farm winter wheat had been sown following potatoes in fields which geese frequented every year. Also for many years the winter wheat sown on this farm had been treated with an insecticide to prevent wheat bulb fly infestations. However, the farmer indicated that this was probably the first time that seed treated with carbophenothion had been used.

Pink-footed Goose casualties on Humberside, January 1975

The Pink-footed Geese breeding in Iceland and Greenland form a closed population that winters in Britain. Atkinson-Willes (1963) stated that the upper Humber area was by far the most important arrival point for the Pink-footed Goose in England with normal populations amounting to 5,000–6,000 birds in early autumn. Boyd & Ogilvie (1969) reported that substantial changes had occurred in recent years in the numbers of Pink-footed Geese using the various wintering areas in Britain with large increases in north-east and central Scotland and decreases on the Solway Firth and in England with the exception of Lancashire. In recent years, even though a large part of the Humber, including the important Pink-footed Goose roosting site on the Whitton Sand has been included in the Humber Wildfowl Refuge, the number of geese using the area has dwindled to approximately 1,500 (M. A. Ogilvie pers. com.). The Pink-footed Geese in the autumn roost on the Whitton Sand and feed on the upland stubbles of the Lincolnshire and Yorkshire Wolds. Later in the winter, they either move to the Wash or frequent the low lying fields close to the Humber that are used to grow winter wheat and potatoes. Newton *et al.* (1974) demonstrated that harvest waste grain is frequently consumed by Pink-footed Geese and may form an important part of their winter diet.

The number of Pink-footed Geese using the Humber Wildfowl Refuge was low during December 1974 but an arrival at the end of

December brought the number present to approximately 1,300. Parties of geese were observed on Sunday 5th January flying to feed on fields to the south of the Humber, returning periodically to rest on the Whitton Sand. The first report of dead Pink-footed Geese was received on Monday 6th January and referred to a number of geese being found on the tide line on the north bank of the Humber opposite the Whitton Sand as shown in Figure 2. Four of these geese that were thought to have died on the Whitton Sand and been washed ashore by the tide were forwarded to the Pest Infestation Control Laboratory (PICL), Tolworth. A report was received on Tuesday 7th January of dead geese being found on the tideline on the south bank of the Humber in the Alkborough Flats area, and four geese were forwarded to PICL, Tolworth. Two geese were sent to the Veterinary Laboratory, MAFF, Lasswade for post-mortem examination. The local Field Staff of MAFF made a concerted effort to search both banks of the Humber, in collaboration with the warden of the Humber Wildfowl Refuge, the Royal Society for the Prevention of Cruelty to Animals and local wildfowling, in order to establish how many geese had been affected. The number of geese found dead on the tideline of the Humber in the vicinity of the Whitton Sand is shown in Figure 2 and amounted to 141. The tides during the period were fairly low and stayed within the main channel thus bodies were carried a considerable distance upstream and downstream. Dead geese were found as far upstream as Trent Falls and downstream as far as Paul. The total number of Pink-footed Geese found dead on the tideline of the Humber, Trent and Ouse was 217 (A. Chapman pers. com.).

On 9th January a report was received of dead geese being found on a newly sown field in the Coleby area. On investigation, it was established that 21 geese had died on 6th/7th January in a newly sown field of winter wheat treated with carbophenothion (as shown in Figure 2), and two geese were forwarded to PICL together with grain samples. A further five geese were reported in a field of growing wheat approximately a quarter of a mile from the previous field. The field details suggest that the Pink-footed Geese had fed in the Coleby area during 5th/6th January, and a large number had subsequently died on the Whitton Sand roost.

The Pink-footed Goose flock using the Humber Wildfowl Refuge had fallen to approximately 300 by 12th January (A. Chapman pers. com.). Thus the number of geese

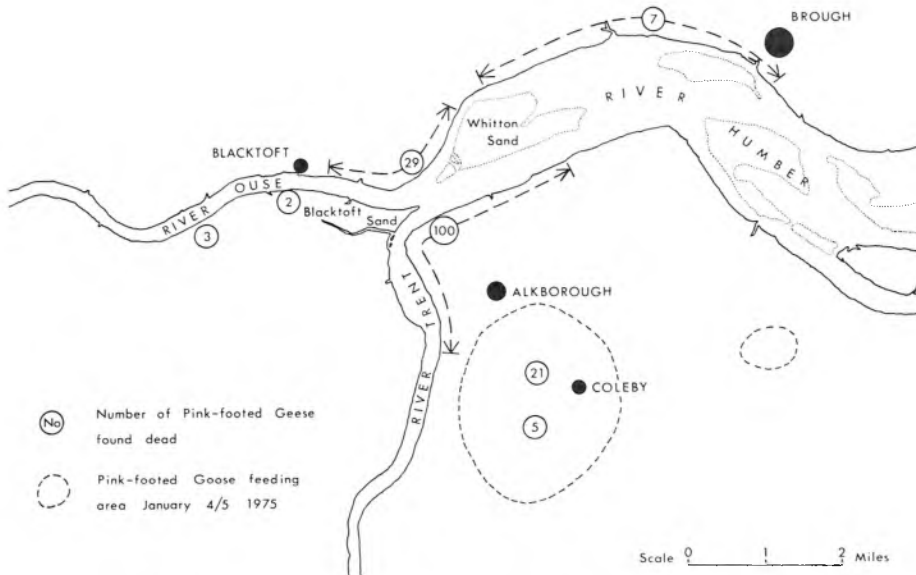


Figure 2. Location of Pink-footed Goose casualties, Humberside, January 1975.

using the refuge had dropped by about 1,000 birds over the period of the incident and a total of 243 geese had been found dead. The exact number of geese affected cannot be determined accurately due to the difficulty in accounting for bodies moving up and down the Humber, Trent and Ouse and the possibility of geese leaving the area.

Laboratory investigations

The goose casualties received at the Agricultural Scientific Services and the Pest Infestation Control Laboratory were subjected to a comprehensive pathological, analytical and biochemical investigation in order to establish the cause of death. The techniques employed were similar to those described by Bailey *et al.* (1972) and are fully documented elsewhere (Hamilton *et al.*, 1975).

The post-mortem examinations revealed no evidence of disease and suggested that the birds had died relatively rapidly with little deterioration in general condition. The gross pathology was consistent with death being due to poisoning. Post-mortem examination of the Greylag Geese revealed the presence of wheat grains in the gizzard and oesophagus and further studies indicated that this grain had been germinating for about three weeks. The Pink-footed Geese contained large amounts of non-germinating wheat grain

which had been dyed red. Brain esterase measurements indicated that substantial inhibition had occurred which is consistent with deaths being due to organophosphorus poisoning. Chemical analysis of the wheat grain from the geese showed that the grain had been treated with both the organophosphorus insecticide carbophenothion and a mercurial fungicide. Carbophenothion residues were detected in brain, liver and muscle samples from the geese. From the esterase measurements and the analytical data, it is concluded that both the Greylag Geese from Angus and Perthshire and the Pink-footed Geese from Humberside were poisoned by carbophenothion.

Discussion

Bailey *et al.* (1972) investigated the death of a large number of Greylag Geese in Perthshire following the autumn sowing of wheat treated with carbophenothion. The basic conclusion drawn from this investigation was that the geese had consumed large quantities of treated grain that had been left exposed on the surface of the field after drilling. The field investigation of the Pink-footed Goose incident on Humberside in January 1975 suggests that this incident was also caused by the geese consuming treated grain that had been left on the surface of the field after sowing. The autumn of 1974 was very wet and this

prevented the drilling of winter wheat on Humberside until January 1975. Even in January the soil at Coleby was too wet to allow conventional drilling of the wheat and thus farmers resorted to broadcasting followed by disc harrowing. This technique inevitably leaves more seed available to the geese than traditional drilling and the geese appear to have consumed the freshly sown treated grain at Coleby and then returned to the roost on the Whitton Sand where many died. It is significant that after the November 1971 Greylag Goose incident in Perthshire, a lapse of three years occurred before the incidents described in this paper, and although carbophenothion had been used during the intervening period, the sowing seasons were generally dry, allowing efficient drilling.

There is no doubt that grain remaining on the surface after sowing presents a hazard to geese but the incidents in Angus and Perthshire in November 1974 reveal that germinating grain can also present a serious hazard to geese. The incidents appear to have been caused by Greylag Geese uprooting germinating grain, in unusual conditions and in sufficient quantities to be fatal. This fact was not established until almost two months after the incidents when information was obtained from Madderty that the geese had died three weeks after sowing. Careful examination of grain taken from birds from all three incidents showed that the extent of germination was similar. It was only at Madderty that bodies were found in a sown field. In the other incidents DAFS field staff were advised to search for fields sown a few days prior to the deaths and were unable to find any. Later, reference to the field data, showed that at the time of the Lundie deaths, the shoots of earlier sown wheat were just emerging in a nearby field and similarly at Scone wheat shoots were just emerging in a field on the same farm. In both instances it was reported that this wheat had been treated with carbophenothion. The weather at sowing time in 1974 had been generally wet, whereas in past years it had been dry, but even more significant it was extremely wet at the time of the geese deaths, with fields being under water and this may have accounted for the ease with which the geese uprooted the grain. The significance of the observations of the farmer at Madderty that 'the bills of the geese were covered with earth as if they had been digging' was now apparent. The earth on the bills of the geese may not have been due to them actually digging, but more from them uprooting seedlings while grazing the newly emerged shoots. The uprooted seedlings would have soil adhering to

them, and this would account for the amount of soil present in the gizzards.

The field investigations in Angus and Perthshire and on Humberside indicated that only Greylag Geese and Pink-footed Geese were involved in the incidents although many other species of grain-eating birds had been observed feeding on fields sown with carbophenothion treated wheat. Thus a large number of birds including Pheasants *Phasianus colchicus*, Wood Pigeons *Columba palumbus* and Rooks *Corvus frugilegus* were observed feeding on the field at Coleby but extensive searches failed to reveal any casualties among these species. Jennings *et al.* (1975) determined the oral toxicity of carbophenothion to Canada Geese *Branta canadensis*, Pigeons *Columba livia* and Japanese Quail *Coturnix coturnix japonica* and found that the three species had a fairly uniform response to carbophenothion. Thus the factors that operate to make the Greylag Goose and the Pink-footed Goose susceptible to carbophenothion poisoning in the field are not understood.

Counts made in Britain in early November 1974 showed that the population of Greylag Geese that breed in Iceland and winter in Scotland numbered 69,000, which represents a substantial part (65%) of the north-west European population while the Pink-footed Goose population that breeds in Iceland and Greenland and winters in Britain numbered 89,000 or about 85% of the world population of this species (Ogilvie, 1975). Thus the incidents described in this paper have not in themselves seriously diminished the British wintering populations of Greylag and Pink-footed Geese but the Humberside incident may have had a deleterious effect on the dwindling local Pink-footed Goose population. However, the significance of the incidents should be recognised in view of the recent withdrawal of dieldrin seed treatments which will inevitably result in the increased use of less persistent, but more acutely toxic, alternatives and of the importance of Britain as a wintering area for these species.

Acknowledgements

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Summary

A series of incidents involving Greylag Goose *Anser anser* casualties in Angus and Perthshire and a single incident involving Pink-footed Goose *Anser brachyrhynchus* casualties on Humberside are described. A full field and laboratory investigation revealed that the geese had died of organophosphorus poisoning after consuming winter wheat treated with carbophenothion. The factors that led to the incidents are discussed.

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