The agricultural importance of wild goose droppings

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Summary

PRODUCTION of manure per bird per day was estimated to range from 175 gms. for the English Canada Goose to 58 gms. for the Barnacle Goose. Droppings were analysed to determine their chemical composition. This was found to reflect the soil and crop on which the birds were feeding and perhaps to some extent their own physiological requirements. On a dry weight basis, content averaged 2.2% N_2, 1.0% P_2O_5 and 2.0% K_2O.Production at this rate and of this quality will not make any significant difference to the soil chemicals and is usually not additive. Rarely trace elements or phosphates may be brought in by geese to land deficient in them. The organic content may help in the maintenance of a good tilth. The accumulation of droppings at goose roosts on inland freshwater lakes is probably sufficient materially to affect the fertility of the water. "Fouling" and contamination by droppings are not important on present evidence.

An investigation of the relation of wild goose flocks to agriculture in Britain, recently undertaken by the Wildfowl Trust, surveyed not only the food removed by the birds but the manure they left behind. Very little information was available on the rate of production of faecal material or its composition. The present paper seeks to provide such information and to indicate whether there are any ways in which the manure is either of positive value or disadvantageous to the farmer.

The average weight of geese in wild flocks was calculated by assuming that the sexes are equal in numbers, and that juveniles constitute a third of the birds. Samples of droppings produced by a number of species when feeding on grass were collected. It will be seen from Table I that the ratio of dropping weight to body weight is very similar in all the species.

Table I. The relation of dropping weight to body weight

	Av. body wt.	Average dry wt. of 60 droppings	Dropping wt. as % of body weight
Barnacle Goose	1.80 Kg. (Boyd unpub.)	0.84g. (Solway)	.02
Pinkfeet	2.52 (Beer & Boyd 1962)	0.77g. (Slimbridge) 0.78g. (Solway)	.03
Russian Whitefront	2.23 Kg. (Beer & Boyd 1963)	0.87g. (Slimbridge)	.04
Greenland Whitefront	2.47	1.04g. (Tregaron)	.04
Greylag	3.14 Kg. (Elder 1955)	0.94g. (Solway)	.03
Mid-western Canada Goose ..	3.80 Kg. (Elder 1946)	1.54g. (Helm 1951)	.04
English Canada Goose	4.64 Kg. (Boyd unpub.)	1.90g. (Slimbridge)	.04

For three species of goose the number of droppings produced daily is known approximately. Penned, wild-caught Canada Geese produced 92 droppings per day in winter (Taylor, 1957). Hand-reared Pinkfeet defaecated at the average rate of 3.6 droppings per hour, that is about 86 per day, also in winter. The approximate rate at which droppings were produced by wild Whitefronts under natural conditions was estimated by sampling in a 19-acre grass field at Slimbridge frequented for only two or three days in two seasons by a known number of geese. In March, 1961 3300 geese in 23 daylight hours produced 3.7 droppings per yard square, in March, 1962 3500 in 51 daylight hours produced 8.9 per yard square. These give dropping rates per individual goose of 4.5 and 4.8 per daylight hour. When the geese roost on the river's edge individual piles accumulate, containing about 10 droppings per bird per night. Allowing for droppings lost in transit and while the bird is bathing and gritting, the production for the complete day is around 80. For these birds, then, it is possible to calculate the weight of manure produced per day. As a percentage of their body weight this is 2.7 for the Pinkfoot, 3.2 for the Common Whitefront and 3.7 for the Mid-western Canada Goose. If it is assumed that a ratio of 3.2 *per cent* of the body weight holds for those species for which there are no data on dropping rate, figures for the weight of dry manure produced per bird per day can be obtained:—

English Canada Goose *Branta canadensis canadensis*	175 gm.
Mid-western Canada Goose *Branta canadensis interior* ..	142 gm.
Greylag Goose *Anser anser*	100 gm.
Greenland White-fronted Goose *Anser albifrons flavirostris*	79 gm.
White-fronted Goose *Anser albifrons albifrons*	70 gm.
Pink-footed Goose *Anser brachyrhynchus*	67 gm.
Barnacle Goose *Branta leucopsis*	58 gm.

These weights should be multiplied by a factor of 5 if a wet weight figure is required.

To obtain the chemical composition of goose manure, fresh samples, each of over 20 grams dry weight, were collected from birds feeding on a wide variety of crop fields. The results of the chemical analyses are set out in the Appendix. The composition of the droppings reflects rather closely the composition of the crop and of the soil on which it is growing. Thus sample 2, which is low in phosphates, was from an area where the soil is devoid of this mineral and sample 10, on the other hand, was taken from a richly fertilised soil. Sample 18 has a low water and potash content, characteristic of the oats on which the Greylags were feeding, and sample 19 has a high water content as would be expected from a diet of swedes. Nevertheless, samples from the same place at different times also show a variation, for instance 21 and 22. This may reflect a change in the condition of the crop or be due to a variation in the nitrogen requirements of the birds according to their physiological condition. While these variations and their causes would make an interesting study, the cost of analysis is high and for present purposes the data in the Appendix are sufficient to give a general indication of composition of wildfowl droppings. The average value for geese may be compared on a dry weight basis with the composition of manures produced by domestic animals as given by McConnell (1958). It will be seen that the wild goose manure is similar to that of cows and sheep but less rich than that of hens. The decomposition rate of goose droppings is relatively rapid. Within three weeks during March, 1961, even in dry weather, the nitrogen in Whitefront excreta had dropped from 4.1 to 1.6 *per cent* and the potash from 3.3 to 1.4 *per cent.*

Table II. Composition of various manures (original and after McConnell)

	% moisture	% N_2	% P_2O_5	% K_2O
Wild geese ..	83	2.2	1.0	2.0
Hens	55	3.3	3.3	1.9
Cows	77	1.7	0.6	1.7
Sheep	67	2.1	0.9	2.4

The amount of fertiliser applied to farmland by the agriculturalist of course varies widely according to conditions and crop. But as an example, the production of one ton of wheat grain and straw draws about 54 pounds of nitrogen per acre from the soil (Ministry of Agriculture, 1957). Now at Slimbridge, even with a resident winter flock in excess of 1000 Whitefronts, repeatedly foraging over 2000 acres, a level of 1 dropping per square foot is considered high. Using the average composition of wild goose droppings this would provide only 1.9 lb. nitrogen, 1.7 lb. potash, 0.8 lb. phosphate and over 70 lbs. organic matter per acre. To lay 54 lbs. of nitrogen per acre would thus require 28 droppings per square foot or 244,880 goose hours (say 1000 geese for 245 hours or more than three weeks on the same acre of grass). Such a heavy goose usage is never encountered. In any case, such plant nutrients as the geese provide have come directly from the soil on which the birds feed and are not additions; of greater importance is the rapid turnover of organic matter in improving and conserving the soil. The droppings contain partly and completely digested compounds and, therefore, nutrients return faster than they would if left to decay or ploughed in. The rapid conversion of spilled grain on stubble fields is a case in point. Here it is an advantage that food passes through a goose quickly so that most of the manure produced is left on the land from which the bird is feeding.

In some cases geese may bring trace elements on to the land which they have obtained when " gritting " elsewhere. Ingram (1933) noted that cattle on the Isle of Gunna, off the Island of Coll, ate Barnacle Goose droppings and that these cattle were in better condition than those on the main island, of similar topography but where the geese were few. Rennie (1958) also observed this habit on Gunna but thought this might indicate a phosphate rather than a trace element deficiency. The phenomenon has not been observed in Islay, however, where there is a known lack of phosphate, but sheep on a farm in Perthshire are reported to eat goose droppings selectively from acid ground where some hundreds of geese roost.

While some goose flocks have temporary roosts on land, which they enrich to some extent, most roost on water. On tidal waters the manure will be so diluted as to be virtually useless; thus, Curry-Lindahl (1962) found that large concentrations of swans on the Baltic coasts caused little difference in the physico-chemical composition of the water. Vladykov (1959) however suggested that the very large (120,000) numbers of geese present for five months on the St. Lawrence shores in Canada must be producing a fertilising effect. On inland waters, an accumulation of fertilising compounds is more likely; Paloumpis & Starret (1960), investigating the situation at Lake Chatocqua, Illinois, calculated that 20 million duck-days a year spent on the 3562-acre lake left 12.8 pounds nitrogen and 17.1 pounds phosphate per acre.

Much work has been done investigating the effect of adding chemical fertilisers to raise the productivity of lakes for fishing (e.g. Holden, 1959). The quantity to be added to a loch to produce a significant effect on the development of freshwater algae depends to some extent on the depth of water, shallow lochs being more likely to benefit. To add a recommended 10 pounds of nitrogen per acre per annum (A. V. Holden, pers. comm.) would require some 10,000 goose-nights per acre, or 500 geese per acre for 20 nights, assuming that each bird leaves 20 droppings at the roost and these weigh 1 gram dry weight each. This usage falls within that known to exist on some major shallow water roosts.

As a preliminary investigation water samples were taken at two such roosts (known to be excellent fishing lochs) in April, 1962 after geese had been there since the previous September. The level of phosphate, which rarely exceeds 0.5 to 1.0 parts per million, was extremely high. In similar samples, taken at the end of May when the geese had gone and there had been considerable plant growth, the phosphate was back to a normal level. The results are not in themselves conclusive but suggest that further research would be fruitful.

A complaint frequently made by farmers is that their cattle and sheep actively avoid land " fouled " by goose or swan droppings. Certainly avoidance of their own faeces is quickly learnt if not instinctive in young mammals (Taylor, 1954). Goose droppings however are not at all like mammalian faeces and, although Mute Swans' droppings look something like those of a dog, there is no unpleasant odour. No complaints were made by farmers about the droppings of Whooper Swans which, unlike those of the Mute, dry out whitish and hard and look relatively inoffensive. Mr. M. A. Ogilvie kindly tasted the droppings of captive geese, both fresh and about 15 minutes after they had been deposited. All contained grass remains only. Whitefront, Pinkfoot and Barnacle droppings were either tasteless or with a grassy flavour; Greylag and Canada Goose droppings were slightly bitter at first, and the bitterness increased, leaving an unpleasant after-taste. The Ministry of Agriculture & Fisheries (1937, quoted by Berry, 1939) referred to domestic geese thus, " owing to the grazing-habit of geese, however, many farmers, especially those living in highly cultivated districts, will not keep them. The objections usually advanced are that four-legged stock will not graze after them, and that they are destructive to the herbage of the pasture. These objections, however, do not appear to be well founded, and have usually arisen from attempts to keep the geese in small fields or in large numbers too closely associated with other stock. Horses, cattle and sheep have all been found to graze freely after geese." On present evidence any avoidance seems just as likely to be due to the fact that the grass where geese have been feeding will be shorter and less rewarding, even to sheep, than elsewhere. Alpheraky (1905) mentioned that Greylag Goose droppings " scorched " the grass on which they fell. No such effect has been recorded in this country. If it were found, it would be due to free ammonia in the droppings, and there is no evidence that this is high under normal conditions.

Suggestions are also made that geese carry weed seeds, potato root eelworm cysts and various disease organisms. Harmon & Keim (1934) and Cooper, Maxwell & Owens (1960) showed that of 32 varieties of weed seed fed to domestic hens only one could be recovered from the faeces still capable of germination. Possibly trampling of ground by geese in wet conditions would favour the dominance of weed plants, especially on poorly managed, over-grazed grassland. Eelworm cysts occur in the dry fibrous roots, not in the potato tubers which are eaten by the geese, and any risk of transport externally, on the feet for instance, would be slight in comparison with that by other agencies. Tuberculosis has never been found in a wild goose by the Wildfowl Trust and only once in a seven year study by Wilson (1960); in any case, avian tuberculosis is not a progressive disease in cattle. Foot and mouth disease is not acquired by geese through contact with infected cattle (Skinner, 1959) though the virus could be transmitted mechanically. Wilson & Matheson (1952) found no grounds for suggesting that birds migrating from northern countries introduce the disease into this country in the autumn.

It is possible that there may be accumulations of bacterial material on water roosts. Thus Paloumpis & Starret (1960) found a rise in coliform and enterococcus counts from Lake Chantangua through the winter which they associated with a rise in the duck population. In the case of coastal waters such as those investigated in Sweden, Curry-Lindahl (1962) concluded that the slight tidal action prevented any demonstrable pollution correlated with swan density. Schlichting (1960) found that, although only a few faecal samples from ducks contained viable organisms, these birds played a major role in the dispersal of algae and protozoa between bodies of water.

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Appendix. **Composition of bird droppings.** Last four figures on dry weight basis.

	Species	Diet	Month	Locality	% Moisture	pH	% N_2	% K_2O	% P_2O_5	% NaCl
1.	Barnacle Goose, *Branta leucopsis*	Grass	Nov.	Solway	84.75	6.5	1.44	1.80	1.20	0.240
2.	,, ,, ,, ,,	Grass	Nov.	Islay	76.25	5.5	1.10	2.70	trace	0.380
3.	,, ,, ,, ,,	Grass	Dec.	Holland	88.50	5.0	1.44	2.70	1.56	0.021
4.	Canada Goose, *Branta canadensis*	Grass	April	Sevenoaks, Kent	87.63	6.5	1.62	3.31	1.86	0.145
From Helm (1951)	,, ,, ,, ,, (average of three samples)	Corn, vegetation and seeds	March and April	Missouri, U.S.A.	66.69	?	2.08	1.42	0.84	?
5.	Pink-footed Goose, *Anser brachyrhynchus*	Old grass	Nov.	Humber	86.60	6.0	1.12	2.35	1.12	0.050
6.	,, ,,	Barley stubble	Nov.	Corston, Angus	82.00	6.0	1.96	1.72	1.29	0.017
7.	,, ,,	Winter wheat	Dec.	Leuchars, Fife	81.80	5.5	1.52	0.51	0.42	0.050
8.	,, ,,	Young grass	Dec.	Leuchars, Fife	82.00	5.5	1.87	1.59	1.24	0.071
9.	,, ,,	Winter wheat	Dec.	Humber	?	5.5	3.98	1.58	1.64	0.201
10.	,, ,,	Winter wheat	Jan.	Hereford	89.41	6.5	1.58	3.78	2.08	trace
11.	,, ,,	Merse grass	Feb.	Wigtown	68.19	6.0	1.42	1.76	0.25	0.022
12.	,, ,,	Grass	March	Rockcliffe, Cumberland	79.39	5.5	2.40	2.43	0.83	0.087
13.	,, ,,	Young grass	April	Strathbeg	81.60	6.0	0.92	1.58	1.09	1.000 approx.
14.	Bean Goose, *Anser fabalis*	Young grass	Jan.	Castle Douglas	92.50	6.0	2.93	0.67	0.15	0.173
15.	Greylag Goose, *Anser anser*	Potatoes	Dec.	Caerlaverock, Solway	83.10	6.0	1.23	1.14	0.56	0.031
16.	,, ,, ,, ,,	Grass	Dec.	Coupar Angus, Perth	82.40	6.0	2.35	2.50	1.12	0.019
17.	,, ,, ,, ,,	Winter wheat	Jan.	Coupar Angus, Perth	86.61	5.5	1.30	1.94	0.22	trace
18.	,, ,, ,, ,,	Oat stubble	Jan.	Blackford, Perth	70.41	6.0	1.60	0.61	0.40	0.010
19.	,, ,, ,, ,,	Swede turnips	Feb.	Bute	90.03	8.5	1.80	2.80	1.10	0.200
20.	,, ,, ,, ,,	Merse grass	March	Wigtown	85.02	5.5	5.90	2.67	2.00	0.114
21.	White-fronted Goose, *Anser albifrons albifrons*	Grass	Nov.	Dumbles, Slimbridge	87.24	8.0	1.41	2.32	1.43	0.065
22.	,, ,, ,,	Grass	Jan.	Dumbles, Slimbridge	79.83	5.5	3.92	1.38	0.89	0.030
23.	,, ,, ,,	Marsh grass	Jan.	High Halstow, Kent	86.20	6.0	5.87	2.87	2.05	0.107
24.	Greenland White-fronted Goose, *Anser albifrons flavirostris*	Grass	Feb.	Tregaron, Wales	81.95	5.5	2.30	2.10	0.09	0.033
25.	,, ,, ,,	Grass	Feb.	Galloway	83.38	5.8	2.80	1.26	0.22	0.018
26.	Mute Swan, *Cygnus olor*	Winter wheat	Jan.	Hereford	87.99	6.0	1.03	3.75	1.58	0.120
27.	,, ,, ,, ,,	Grass, aquatic plants and bread	May	Patch, Slimbridge	89.20	5.5	2.13	3.34	1.67	0.185
28.	Whooper Swan, *Cygnus cygnus cygnus*	Winter wheat	April	Aberbothrie, Perth	?	6.5	1.15	0.79	0.42	0.210
29.	,, ,, ,,	Grass	April	Strathbeg	88.70	6.0	1.06	2.92	1.77	trace
30.	Wigeon, *Anas penelope*	Grass	Jan.	Dumbles, Slimbridge	84.95	5.8	2.70	2.40	0.20	0.133
31.	Partridge, *Perdix perdix*	Winter wheat	Jan.	Hereford	87.60	6.6	1.73	2.58	0.97	0.008

Note: Small traces of Calcium were detected throughout all samples, but are less than 0.001% as Ca^{++} except for sample 13 which contained considerable amounts of grit and some cinder, and Ca and Na were both high, Ca 2.7% approx.