

XX. ECOLOGICAL ASPECTS OF THE OCCURENCE OF GEESE ON LAKES OF THE GDR WITH RESPECT TO SOME HYGIENIC PROBLEMS

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The waterfowl research program dealing with the distribution of Geese in the GDR under the direction of Prof. Dr. Rutschke creates some ecological questions, too. In this case investigations were made into possible negative and positive effects of feeding in agricultural areas with a greater number of Geese, investigations into influence on the trophy of waters through the import of nutrients, into the daily rhythm and the radius of action of resting geese at the resting and sleeping sites, and into the ecological demands of the Grey-lag Goose on breeding sites.

Some of these questions have been answered satisfactorily and have led to important results, e. g. from Naacke (1966, 1973), Rutschke (1964, 1978), Schröder, (1973), Frädrieh a. Naacke (1974), Bersiner (1976), Litzbarski a. Loew (1976), Rutschke a. Schiele (1980).

Further aspects and results will be dealt with now.

I. Marking of ecological conditions at the resting and breeding sites of geese

It is an essential advantage of our Centre of waterfowl research that we have access to good ecological characteristics of all larger waters, firstly in the Register of waters of the GDR, secondly in the Katalog of wetlands from international and national importance for waterfowl. This gives us the possibility of knowing and of finding out the relevant ecological factors for the occurrence of geese. But of the very small breeding waters of the Grey-lag we know only too little. Unfortunately, just many of such waters are occupied, e. g. small ponds, lakes and peatlands. So the picture of Grey-lag's ecology must still be incomplete.

Resting sites of the Bean Goose and White-fronted Goose

There are about 90 resting sites in the GDR covered by geese every year. They are concentrated in the northern and central districts. Most of them are natural lakes. In the southern parts of the GDR there are especially smaller ponds and other artificial waters, e. g. impoundments and remainder waters of Brown Coal Mines. We have prepared an analysis of the ecological conditions with regard to the largeness of lakes on ponds, to the depth of waters and to the trophy (Table 1-3).

Table XX/1.

Largeness of resting sites of the Bean and White-fronted Goose in the GDR (number of waters = 75)

Degree of largeness (area)	Number of (lakes and ponds) resting sites	Number of waters in the GDR total (without ponds and running waters)
20 ha	4 (ponds only)	800
20 - 99 ha	16	480
100 - 299 ha	28	65
300 - 999 ha	19	55
1000 ha	8	14

Table XX/2.

Depth of sleeping sites of the Bean and White-fronted Goose in the GDR (number of waters = 75)

Degree of maximum depth	Number of resting sites	Degree of average depth	Number of resting sites
2 m	21	1 m	19
3 - 10 m	29	1 - 3 m	33
11 - 30 m	19	3 - 10 m	17
30 m	6	10 m	6

Table XX/3.

Trophy of resting sites of the Bean and White-fronted Goose in the GDR (number of waters = 75)

Scale of trophy	Number of resting sites	% resting sites	Total numbers of waters in the GDR (%) (lakes)
oligo-mesotrophic low eutrophic	3	4	1
deep lakes	11	15	9
shallow lakes	13	17	7
eutrophic	39	52	73
high eutrophic	9	12	10

A comparison of the results shows that depth as well as largeness as trophy of waters are not important for geese. Nevertheless, it is obvious that the larger lakes are preferred. There are 14 very large lakes with a surface of more than 1000 ha in the GDR. 8 of them are resting sites of geese. If there are larger lakes in an area the geese will accept them, too.

A total of about 70% of all resting waters are larger than 100 ha, although there are more than 1250 lakes with a smaller surface (= 90%), and about 135 lakes with an area of more than 100 ha (= 10%) only. The smaller resting sites, e. g. Lake Grössin in the district of Potsdam, have other neighbouring lakes which the geese can fly if they are disturbed, for instance through hunting or fishing.

Moreover, the geese prefer lakes with lower trophy and smaller depth probably. With regard to the trophy we must consider that in autumn and winter the lakes have clear water without phytoplankton and other loading substances so that the characteristics of those lakes are quite similar to lower eutroficated lakes. Therefore we must find out other important factors for the occurrence of geese at waters, too. I think, the best ecological conditions are the following:

- Territorial position of resting sites near good feeding grounds like alkaline peatlands, grasslands and agricultural areas with wintercorn in the middle in an area of 15 km to the resting ground.
- Existence of small wooded shores and shallow shores.
- No disturbance at the resting waters in the evening, if they come back to the lake.

Resting sites of Grey-lag

The situation of resting sites of Grey-lag differs greatly. The change from one of resting site to another in the various seasons, e. g. in spring by non-breeders, in summer and in autumn by migrating geese has been investigated e. g. by Frädrieh a. Litzbarski (1975, 1976). However, the conditions of resting sites preferred by the Grey-lag are the same as those of *Anser fabalis* and *Anser albifrons*. Firstly, we have some large lakes (Lake Krakow, Lake Gülpe, Lake Plau and Lake Schwieloch) which will be frequented by the Bean Goose and White-fronted Goose together with the Grey-lag at the beginning of autumn. On the other hand, we have found many smaller waters like ponds, peatland and small lakes as resting sites of the Grey-lag, too. It is very difficult to find out the essential ecological criteria of the Grey-lag's resting waters. But we think the ecological conditions are quite similar to those of *Anser fabalis* and *albifrons*.

Breeding sites of the Grey-lag Goose

The stock of the breeding population has increased since 1960 in the GDR.

We have estimated the number of breeding sites to more than 450–500.

This is the background for investigations of the ecological conditions of the breeding sites. The results of first investigations are still unsatisfactory.

It is a fact that the ecological conditions that are favoured by the Grey-lag are not measurable with the general status of the waters, e. g. trophy, depth, largeness, water quality. This species is very strongly dependent on the terrestrial conditions in the feeding grounds, not on limnological conditions and especially not on waterchemistry or waterbiology. This is an important differ-

ence with regard to other wildfowl. On the other hand, it is necessary to have a highly structured vegetation on shore and good attainable feeding grounds near the waters. These are the suppositions of settlement of waters by geese (see also at *Hudec a. Rooth*, 1970). In the GDR the main ecological characteristics of waters covered by geese are the following:

- Alternation of dense and loose shore-vegetation mainly composed by Phragmites, Typha, Salix and other underwood
- Shallow water near the shore
- Existence of islands and dams with a high density of plants
- Strong structuration of the shoreline
- Possibilities of getting out of the water at shallow shores without vegetation by geese families.
- Existence of feeding grounds near the water.

II. Effects of a high density of Geese on resting sites

The problem of eutrofication

Dobrowolsky (1973) and *Kalbe* (1978) have shown that the import of nutrients and organic substances can bring forth some negative effects in water-ecosystems (eutrofication, oxygen consumption). But theoretical model-investigations have proved that the load by waterfowl is not so high. The whole balance of nutrients and the turnover of substances in the ecosystem will be determined mostly by other processes, e. g. by the import of nutrients, by sewage and wastewater, imports of phosphorus and nitrogen by agriculture and fishery. So we cannot find any limnological model of substances which regards the import of nutrients by geese and other waterfowl today. But it is imaginable that there is a negative influence on the status of eutrofication by geese with regard to the following conditions:

1. High density of waterfowl with a high grazing rate of plants followed by an increase in the turnover of nutrients, especially in summer. The negative effects may be: Intensive development of phytoplankton, water disturbance, development of waterblooms, decrease of transmission of light into the water. Doubtlessly this will only arise in special situations, because the feeding of waterplants brings forth normally a decrease of nutrient contents in an ecosystem. It would be necessary to have a sudden immigration of high numbers of waterfowl only. In our area we have not found any such situation up to now.

2. Another point of view is the presence of many waterfowl are fed outside the waterecosystem and then fly to the water there, where they put their excrements with nutrients into the water. This refers to geese and gulls.

Rutschke and *Schiele* (1980) have done research in this field at Lake Gülpe with regard to Bean Goose and White-fronted Goose. In the autumn there are 10 000 and more geese at the lake. *Rutschke* and *Schiele* have found that 10 000 geese will import 2,2 kg P and 5,2 kg N to the lake daily, which in 40 days from the middle of October to the end of November amount to a total of 88 kg P and 208 kg N. The lake has an area of 600 ha and an average depth of 0,5 m. It contains 3 million m³ of water, with 450 kg P and 300 kg

inorganic and organic N dissolved in it. From the faeces of the geese, the lake gets nearly 20% of the total amount of P dissolved in the water. The increase of nutrients content in the lake Gülpe would doubtlessly be the beginning of eutrofication with negative conditions. *Rutschke* and *Schiele* refer to the modelcharacter of this account explicitly because the accumulation of nutrients in about 40 days is possible only if we do not have anything that changes the quantity and quality of water in the lake. Actually, a small river, the Rhin flows through the lake with the waterflow of 4 to 6 m³/sec during resting time. Therefore the average time of stay is 6 to 10 days only and the accumulation of nutrients is possible about 6 to 10 days only, too. Moreover, the import of nutrients goes on mainly in autumn and winter, so that the metabolism of matter is decreased.

Nevertheless, the example shows that especially with small loaded lakes without an exchange of water resting geese can bring a high degree of eutrofication with changes for the worse of the ecological conditions for other waterfowl. Especially some of the smaller shallow lakes with a well-developed submerged waterplant-vegetation are endangered. In the GDR the following lakes belong to this type: Lake Putzar with 19 000 geese the maximum, Lake Koblentz (8000 geese), Lake Breesen (4000 geese), and Lake Felchow (20 000 geese). It is possible, that the defense against geese is necessary for the preservation of the good ecological and limnological condition of these waters.

It shows a calculation for the lake Felchow, a small lake with an area about 40 ha.

Largeness of lake: 40 ha

Middle depth: 0,5 m

Volume of water: 0,2 million m³

Import of nutrients: 88 kg P, 208 kg N

Load of surface: 0,22 g P/m²·a, 0,32 g N/m²·a

Critical loads according to VOLLENWEIDER (1968): 0,07 g P/m²·a,
1,0 g N/m²·a

Critical loads according to KALBE (1976): 0,13 g P/m²·a,
1,0 g N/m²·a

This loads surpass the critical value of 0,07 g P/m²·a.

Hygienic aspects

Wild geese are, like other ducks or gulls, potential carriers of Salmonellosis (Typhus, Paratyphus, typhoid Fefer). The possibility of infection of man will be diminished at time of migration of geese (September to April). At this time we can eliminate the possibility of infection during recreation activities of people (for instance bathing). Greater danger could come from abundant resting Grey-lag geese at beaches in summer.

Excrementation at such places may be very problematic. In the GDR we have not found any infections of man by geese, fortunately.

An other point of view is the hazard to waterfowl by *Clostridium botulinum* in highly eutroficated waters in summer, and also the potential infection by man. This problem has been investigated by *Feiler* and *Köhler* (1976) with regard to the area of the river Havel.

III. Importance of Geese as Bioindicators

The term bioindication of loads or of hazards and of the stability of ecosystems has found its way into many branches of ecology in the last decades. Whereas bioindication of air pollution and of water pollution has been used by forestry and water management for a long time already the importance of birds as indicators has not been known up to now. Of course, ornithologists have pointed out the possibility of indication of biocids by birds as consumers of the second or third compartment of the feedchain, but theoretical considerations on the possibility of general bioindication by birds have been published by *Rutschke* and *Kalbe* (1980) at first recently. So, birds are good indicators, although there are some difficulties because normally birds show changes in their distribution:

– The homothermy and intensity of metabolism are suppositions for the strong dependence of populations on environmental factors. Birds are very sensitive to them.

– The position of most species of birds in the ecosystem has been well defined, and so it is possible to find out changes of the environment.

– Qualitative and quantitative changes of the birdfauna can be accessed easily.

The geese as relatively spectacular birds have a special position in this case. The value of indication will decreased radically by reason of the lower position in the feedchain (second compartment as consumers of the first step). The indication of pollutants by the feeding of contaminated plants is well-known, e. g. for mercury and other toxic salts of heavy metals.

Above all, the breeding population of Grey-lag has a great importance as indicator of the whole changes in waterecosystems, if we want to review the variety, stability and mechanisms of regulation as suppositions for the preservation of landscape. The Grey-lag is an important member of many waterecosystems in the GDR. In connection with the typical combination of species the Grey-lag indicates a generally variable landscape although it shows only little dependence on limnological ecofactors. The typical fauna of birds of a natural shallow lake with clear water would be characterised, e. g. by the following combination of species:

Anser anser – *Anas platyrhynchos* – *Anas querquedula* – *Anas crecca* –
(*Anas acuta*) – *Spatula clypeata* – *Podiceps ruficollis* – *Podiceps nigricollis* –
Podiceps cristatus – *Rallus aquaticus* – *Gallinula chloropus* – *Fulica atra*.

Some of these species have a higher weight of indication than others. The term "species diversity" (D), which was introduced into ornithology by *Bezzel* and *Reichholf* (1974) and *Höser* (1976) is a good characteristic of the ecosystem-variety:

$$D = \sum_{i=1}^s \frac{N_i}{N} \ln \frac{N_i}{N} \cdot 1,44 \quad (1)$$

The term of the rate of missing species (A) according to limnological research by *Kothe* (1962) with regard to ornithological research by *Kalbe* (1978) seems to be more fitting:

$$A = \frac{A_1 - A_x}{A_1} \cdot 100 \quad (2)$$

Table XX/4.

Appendix: Weight of indication (i)
by breeding waterfowl in

Black-throated Diver	2,0
Great Crested Grebe	1,0
Red-necked Grebe	1,25
Black-necked Grebe	1,5
Little Grebe	1,25
Cormorant	1,5
Heron	1,0
Little Bittern	1,5
Bittern	1,25
Mallard	1,0
Teal	1,5
Garganey	1,25
Gadwall	1,5
Pintail	2,0
Shoveler	1,5
Tufted Duck	1,25
Pochard	1,0
White-eyed Pochard	1,75
Goldeneye	1,75
Goosander	2,0
Grey-lag Goose	1,5
Mute swan	1,0
Mute Swan (Wildpopulation)	1,5
Lapwing	1,0
Little Ringed Plover	1,25
Snipe	1,5
Curlew	1,5
Black-tailed Godwit	1,75
Redshank	2,0
Common Sandpiper	1,75
Ruff	2,0
Common Gull	1,25
Black-headed Gull	1,0
Black Tern	1,25
Common Tern	1,5
Coot	1,0
Moorhen	1,25
Water Rail	1,0
Spotted Crake	1,25
Little Crake	1,75

Typical stock of breeding birds in natural areas of waterfowl

Clearwater shallow lake: *Podiceps cristatus*, *griseigena nigricollis*, *ruficollis*; *Ixobrychus minutus*; *Botaurus stellaris*; *Anas platyrhynchos*, *crecca*, *querquedula strepera*, *acuta*; *Spatula clypeata*; *Aythya ferina*; *nyroca*; *Anser anser*; *Cygnus olor*; *Larus ridibundus*; *Chlidonias niger*; *Fulica atra*; *Gallinula chloropus*; *Rallus aquaticus*; *Porzana porzana*;
 Alcaline peatlands: *Anas platyrhynchos*, *querquedula acuta*; *Spatula clypeata*; *Anser anser*; *Vanellus vanellus*;
Gallinago gallinago; *Numenius arquata*; *Limosa limosa*; *Tringa totanus*; *Philomachus pugnax*;
 Oligotrophic lake: *Gavia arctica*; *Podiceps cristatus*; *Anas platyrh.*; *Bucephala clangula*; *Mergus merganser*; *Cygnus olor*; *Fulica atra*.

So, we have the possibility to ascertain the causes of environmental change if we have obtained the stock of breeding birds through investigations over a long period of time. A high rate of missing species indicates essential changes of the environment. If we know the typical breeding stock of a natural water-ecosystem we can find out the actual theoretical rate of missing species (A_T). The result will give us the actual step of impoverishment of the ecosystem.

$$A_T = \frac{\sum(A_0 \cdot i) - \sum(A_x \cdot i)}{\sum(A_0 \cdot i)} \cdot 100 \quad (3)$$

A_0 is the theoretical stock of breeding species, i is the weight of indication from 1,0 to 2,0 (Appendix).

Firstly we must find out the typical breeding stock in all natural water-ecosystems. After calculating A_T in the second step we must formulate the aims of management and preservation.

In this case we are only at the beginning of our investigations. But I hope this will be a good possibility of preserving nature and with this preserving waterfowl too of course.

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