

## EFFECTS IN PREDATOR-PREY INTERACTION BETWEEN RED FOX AND PHEASANT IN MÜNSTERLAND (GERMANY)

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### ABSTRACT

Nyenhuis, H.: EFFECTS IN PREDATOR-PREY INTERACTION BETWEEN RED FOX AND PHEASANT IN MÜNSTERLAND (GERMANY) : The population of the pheasant (*Phasianus colchicus*) in Münsterland, Germany, shows two cycles of abundance (hunting bags) during the time from 1961/62 to 1996/97. During this 36 year time-file, the red fox (*Vulpes vulpes*) bag stagnated until the end of the 80's, however, increased immensely after 1986/87 with two peaks at file' end. PEARSON's correlations with the species' bag-files and 36 time-files of monthly weather data found out effects between the animal populations and also weather influences. Up to 10 weather variables could be applied in linear multiple regression analyses. In the following, we present correlation coefficients  $R$ , standardized regression coefficients (Beta) and T-values. The red fox population from the previous year, represented by the bag from the previous year, is mostly responsible for the population increase. The second step, the pheasant bag, shows a remarkable negative value as a consequence of pheasant's decline in relation to the 36 year period. The highest significant result with the pheasant bag is the simple correlation of temperature in the month of June, whereas 10 variables spectrum should also be regarded, during the bird's breeding period. This appears to be responsible for the development of invertebrates brood, under the aspect of the temperature in May. Many warm, dry and sunny days in the summer months give rise to an increase of the population, particular in August, when chicks of a second brood are born. The favourable influence of the pheasant population of the previous year as well as the negative red fox effect are of high importance in the birds table of ecological variables.

### 1. INTRODUCTION

The red fox's good choice is adapted to the population dynamics, consequently the density of its prey. The foxes' bill of fare reaches from worms and mice up to fawns and ripe plums. Papers on ecology of the red fox in relation to small animals point to a dependence of predation on environmental conditions. In fact, something is known about foxes' preying upon gamebirds by analysis of faecal material and stomach contents (LAMPIO, 1953; BEHRENDT, 1955; GOSZCZYNSKI, 1974; REYNOLDS AND TAPPER, 1995). Only few estimates on the effects of red fox bags on small game hunting bags were made in Germany (FRANK, 1970; SPITTLER, 1972; NYENHUIS, 1996). With this paper, we attempt to present estimates of the red foxes and the pheasants in a large biotope preferentially used by these birds. In order to receive a complete ecological model under mathematical aspects, we had to compute the

animal abundances together with the data of weather conditions. The independent variables of temperature, rainfall and sunshine indicate the pheasant's dependence during the winter, spring and summer months on weather conditions. However, detailed records which would allow to determine the influence of conditions at their daily best or worst are not suitable in this study for models format. We also refrained from showing equally interesting correlations with the autumn months when the birds are bagged, because they mainly determine hunting success and perhaps hunting pressure.

## 2. STUDY AREA

The study was carried out in the Münster region, preferentially densely populated by pheasants (51°30' - 52°32' N, 6°25' - 8°20' W, **Figure 1**). The ca. 505,000 ha hunting grounds are covered by 16% woodland. Deciduous forests with oak (*Quercus robur*) and beech (*Fagus sylvatica*) cover 50% of the wooded area. Arable land amounts to 61%, 38% of which is used for maize and corn-cob-mix (*Zea mays*) growth. About 17% of the hunting area is cultivated as pasture land (STATISTICS, 1995). In this type of lowland agricultural landscape – mainly sandy podzol, brown podzolic soils on Pleistocene and Holocene sand – the annual precipitation amounts to 770 mm, and the temperature to 9,6°C with 1,9°C in the month of January (mean values for a 36year period of research).

## 3. MATERIAL AND METHODS

As an indicator for the pheasant and red fox populations we used the hunting bags including the seasons 1961/62 to 1996/97, placed at our disposal by the office of Dr. H. SPITTLER (Forschungsstelle für Jagdkunde, Bonn). These records from the territory of Münster (Münster, Borken, Coesfeld, Recklinghausen, Steinfurt, Warendorf districts and the townships of Gelsenkirchen and Bottrop) were added to 36 year time-files. These chronologies were established for PEARSON correlations® with series of the 12 month weather data (temperature °C, precipitation mm and sunshine hours – ANONYMUS, 1961 to 1996), by using mean values from weather stations Münster and Bocholt. Together with the bags of the previous years, 10 weather variables could be applied in two linear multiple

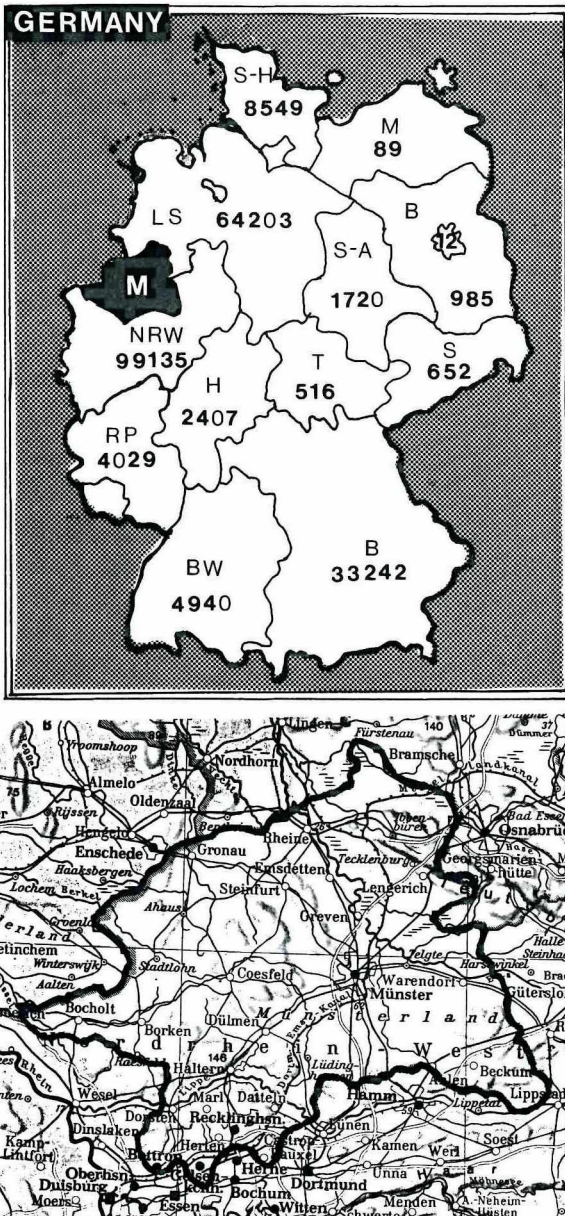


Figure 1.: Location of the study area (M = Münsterland) in the Federal Republic of Germany. Numbers refer to pheasant bags in the Federal Land's hunting season 1996/97 (after DJV Handbuch Jagd 1998.).

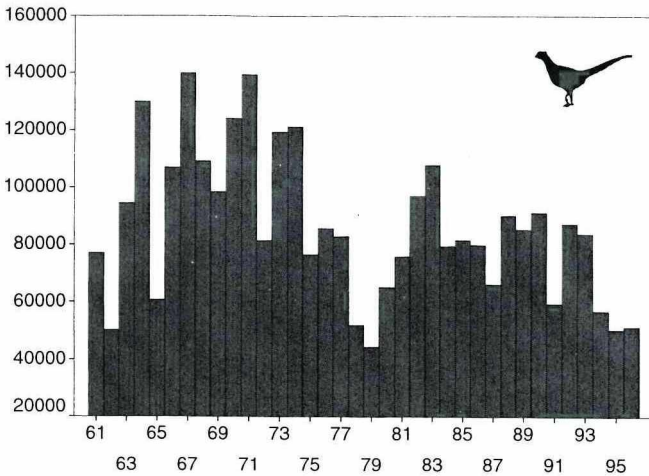
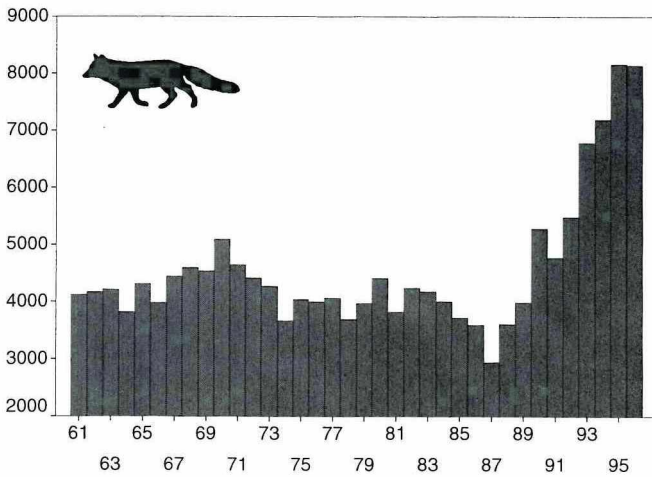


Figure 2.: Red fox hunting bag (above) and pheasant bag (below) in the territory of Münsterland from 1961/62 until 1996/97.

regression models (KIM AND KOHOUT, 1975). In order to explain the share of variable influences, it is essential to calculate them in accordance with the standardized regression coefficients (Beta) and the T-values. Following the regression tests, the most important ecological results are scheduled in tables. Calculations and time-series were drawn at the Information center - University of Osnabrück - using SPSS-7,5 programs on windows NT.

### **Hunting bags 1961/62 to 1996/97**

One can compare the animals' bag-ratios (**Figure 2.**), where the mean value of the pheasant shots amounts to 87450 birds, and that of the fox 4578 shot and caught during the same period. Almost 140000 pheasants could be bagged in the seasons 1967/68 and 1971/72. The maximum in the red fox diagram amounts to 8168 animals in the 1995/96 hunting season. With regard to the pheasant bags, there is good reason to believe that the population on several hunting grounds was supported by release of hand-reared birds.

## **4. RESULTS**

A characteristic feature of the area investigated, a parklike landscape, is the cause for the fact that the red fox density is not very high whereas the established pheasant population grew stronger here than anywhere else. The PEARSON correlations were known, 76 coefficients gave information on each relation. Though the number of variables is sufficiently high, the multiple regression program, which draws variables in a satisfying line, came to a stand still with the maximum of 12 variables (**Tables 1. and 2.**). Nevertheless, in any case, the quadratic R amounts to more than 0,50 (50%) of variance explained (red fox = 0,68 and 0,63 in the pheasant table).

For comparison, the estimated regression values of pheasant bags with those of the foxes and weather data were drawn in **Table 1**. These coefficients varied in their percentage from 3% to 10,6%. High valuations are found in the relation with the pheasants of previous year and rather the same result was achieved with the red fox bag. There are calculations of three winter months of medium percentage with a negative influence of precipitation in January and in the month of March. Sunshine hours still show a remarkable effect by the PEARSON correlations in February, however, the lowest positive relation was noted in the Beta announcement. During spring, three of five values are below on the average. Obviously, the population of pheasants is highly favoured by temperature increases in the month of May.

**Table 1:** Linear multiple regression of the pheasant  $R = 0,79$ .  $R$  = multiple correlation coefficient, PEARSON's  $r$ , Beta = standardized regression coefficient, mm = precipitation, °C = temperature, shs = sunshine hours, \* significant, \*\* highly significant.

| Variable                  | r      | T     | Beta  | = %    |
|---------------------------|--------|-------|-------|--------|
| Pheasant of previous year | 0,37*  | 2,21  | 0,34  | 9,2 %  |
| Red fox                   | -0,14  | -1,82 | -0,33 | 9,0 %  |
| January mm .....          | -0,34* | -1,21 | -0,22 | 6,0 %  |
| February °C .....         | 0,21   | 0,71  | 0,11  | 3,0 %  |
| March mm .....            | -0,33* | -1,27 | -0,21 | 5,7 %  |
| April °C .....            | -0,05  | -0,85 | -0,14 | 3,8 %  |
| April shs .....           | 0,08   | 0,85  | 0,15  | 4,1 %  |
| May °C .....              | 0,31*  | 2,14  | 0,39  | 10,6 % |
| June °C .....             | 0,35*  | 0,42  | 0,11  | 3,0 %  |
| June shs .....            | 0,29*  | 1,18  | 0,31  | 8,4 %  |
| August °C .....           | 0,24   | 1,34  | 0,36  | 9,8 %  |
| August shs                | 0,22   | 0,82  | 0,24  | 6,4 %  |
| Residuals                 |        |       | 0,77  | 21,0 % |

**Table 2.:** Linear multiple regression of the red fox  $R = 0,83$ . For explanations, see **Table 1**.

| Variable                 | r      | T     | Beta  | = %    |
|--------------------------|--------|-------|-------|--------|
| Red fox of previous year | 0,85** | 3,68  | 0,61  | 25,8 % |
| Pheasant                 | -0,14  | -1,58 | -0,24 | 10,2 % |
| January °C .....         | 0,18   | -0,35 | -0,07 | 3,0 %  |
| January shs .....        | 0,23   | -0,16 | -0,03 | 1,2 %  |
| February °C .....        | 0,20   | 1,19  | 0,20  | 8,5 %  |
| February mm .....        | 0,02   | 0,36  | 0,06  | 2,5 %  |
| February shs .....       | -0,11  | -0,35 | -0,06 | 2,5 %  |
| May °C .....             | 0,28*  | 1,38  | 0,20  | 8,5 %  |
| May mm .....             | -0,19  | -0,55 | -0,08 | 3,4 %  |
| June mm .....            | -0,16  | -1,08 | -0,15 | 6,4 %  |
| July °C .....            | 0,39** | 0,32  | 0,08  | 3,4 %  |
| July shs                 | 0,34*  | 0,63  | 0,18  | 7,6 %  |
| Residuals                |        |       | 0,40  | 17,0 % |

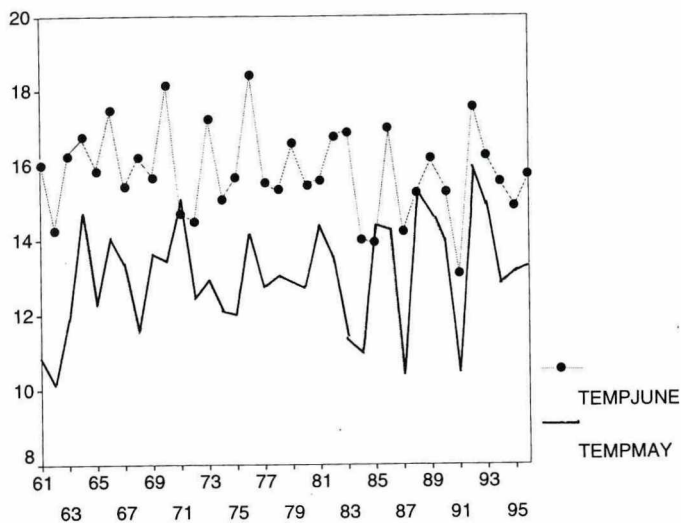
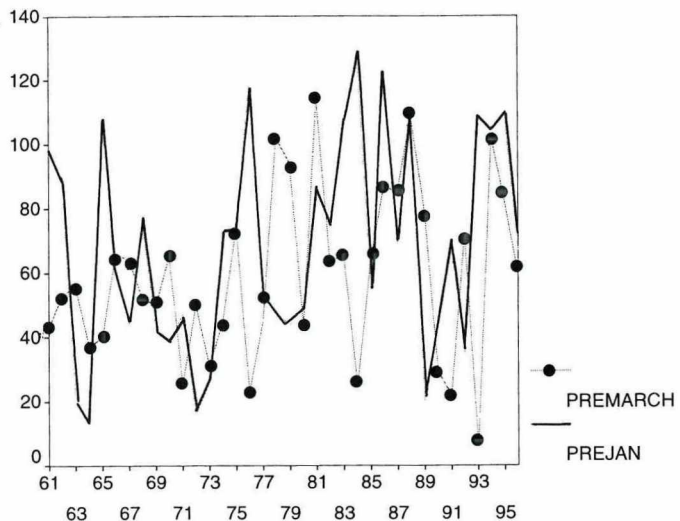
The negative influence of higher temperature on the pheasant in April should not be ignored. Sunshine hours in June seem to correspond with the temperature valuation of the previous month. Plenty warm and sunny days, highly determined by the temperatures, are favourable for the birds' population growth in August.

By weighting of the regression model, compared to significantly strong relationship, the red fox estimations show the conducive influence of the previous year population (**Table 2.**). The pheasant single correlation with the fox bag, lower than the average, was transformed by the regression program to an effect of second spread in the red fox table. Temperature and sunshine reveal as lowest but negative effects on the fox in January. On the other hand, temperature and precipitation are favourable for the predators in February. In the same month sunshine shows a negative correlation. The positive effects of climate factors on the pheasant densities in May and June is paralleled by the value of temperature effect on the fox in May. Precipitation does have a negative influence on the fox during this season. The highest estimates in PEARSON correlation with the temperature comes to a rather low positive result of Beta valuation in July, but a more significant factor in the red fox spectrum is the favourable effect of sunshine hours in this early summer month.

## 5. DISCUSSION

Predator and prey interrelationships together with weather conditions raise many questions. The immense red fox increase counts highest valuations compared with the 60's and 70's years. This stands for a successful offspring production and indicates the availability of adequate diet. It becomes evident, that the fox's influence on pheasant population is reflected similarly by the pheasant's influence on the fox population. This implies that the fox's preying on these birds is responsible for the large decline in pheasant density, today even more than ever (SPITTLER, 1972; VON SCHANZ in ARTOIS and BOUCHARDY, 1986). REYNOLDS *ET AL.* (1988) published 20 year curves of bag records from Southern Jütland during pheasant bag increase and one of the red fox decline during the increase of rabies from 1964 to 1974. For studies on the red fox population it might be interesting to know, that in the main rutting time, when temperature and sunshine play an important role for the survival of the fittest adult pheasants, the same weather factors stand for negative influences on the predator population in the month of January.

During winter seasons, losses of gamebirds, particularly those of non-migrating birds like the pheasant, can be dramatic. However, extremely low temperatures like during the „cold spell“ of early 1963, when many pheasants died (ASH, 1964), and a severe winter like 1978/79 could be regarded as exceptional for the Westphalian lowland of the Münster area. In January 1993, 1994 and 1995 snow falls amounted to 109 mm in the study region (**Figure 3.**), a maximum of 21 days was snow covered so that pheasants had to scratch their way through



**Figure 3.:** Time-rows of precipitation mm (above) and temperature °C (below) in different months, mean values measured in Münster and Bocholt weather stations from 1961 to 1996.

the soft snowcover, looking for food on fields of autumn sown wheat, barley and rye. Neither temperature nor snow appeared to be a problem in recent years. The cock pheasant courtship usually starts in the month of March, copulations, however, take place mostly in April (DIEZEL und MÜLLER-USING, 1970). Might it be that these higher temperature in April have a negative effect on pheasant recruitment efficiency? Calculations with a pheasant bag-file of western Lower Saxony show a more significant negative correlation with the temperature variable of this month ( $r = -0.36$ ). During the female egg-laying and the development of invertebrates, the temperature has a favourable effect on the birds' population in the month of May. The data series therefore (Figure 3.) correspond with the birds' bag-file. KROLL (1973) and BEHNKE (1980) reported for the chicks' hatching success, that warm and sunny weather is favourable in June. Relations between lowest temperature in June 1991, after a lapse of 36 years (Figure 3.), and the decline of the birds' bag compared with the influences of different land use are discussed by NYENHUIS (this volume). Weather is an important factor for determining annual variations in the invertebrates' level. Plant bugs are more abundant during chicks' hatch if temperature in May does not drop below 12°C on average. In any case, low temperature will increase energy needs. For example BERGMANN (1987) explains the high energy demands of nidifugous birds as temperature dependent. Also protein diet favours the growing of the chicks at faster rate, so that they are able to fly and to escape ground predators earlier. In our study area there are mustelid hunting bags of highest density per ha hunting area, compared with other regions in the Federal Land of North Rhine-Westphalia. Polecat (*Mustela putorius*), Stoat (*Mustela erminea*) and Weasel (*Mustela nivalis*) register increasing hunting bags (NYENHUIS, 1998). In June 1998, adverse weather conditions in Münsterland area, during the chicks' hatching, influenced also chick mortality. In favourite pheasant habitats between Osnabrück and Münster, we often found females with only one chick.

Other density-dependent factors are also the predators. Clutch losses and preying on the brooding female will be important causes' for the decrease in pheasant population. In case of replacement clutches, if the first nest has been destroyed, chicks may hatch in the month of August. So it will not be a surprise that temperature and sunshine appear as favourable factors in this month. On the other hand, the release of young sensitive farm-bred birds happened mainly in August. A modern study of released pheasant influence on the wild population was made by KAMIENIARZ (1993), who selected cases where the efficiency of releasing farm-bred birds was constantly dropping. These are areas of intensive agricultural use and those with forests where large numbers of predators are present, where it seems necessary to stop releasing. In Münsterland hunting-grounds, where the pheasant is mainly shot, hunters

consider it necessary to release hand-reared birds (SPITTLER, pers. com.). Thus, wild stocks will be protected because wild populations will not be overutilized. Here, releasing of hand-reared birds is permitted by prohibition from 1992 later than 1<sup>st</sup> of August. Like in Hungary the rate of artificially reared pheasants declined from 60% (NAGY, 1986) to 34% and 47% (SZENDREI, 1996), a decline of released birds in North Rhine-Westphalia can give reference to the decrease of the pheasant hunting bag during this study last three years.

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