

SEASONAL CHANGES IN SELECTION PRESSURE IN SOME EUROPEAN  
BIRDS OF PREY (FALCONIFORMES) AND OWLS (STRIGIFORMES)

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Abstract. In most animals, the predation by other animals plays a very important role as a selection factor. It is the aim of the present paper to analyze selection factors and pressures in predators in which the selection through predation seems to be lacking wholly or wholly but a little. The problem was studied in four European birds of prey (*Falco tinnunculus*, *Buteo buteo*, *Accipiter gentilis*, *Accipiter nisus*) and three European owls (*Tyto alba*, *Asio otus*, *Strix aluco*).

By excluding birds killed by man what may simulate natural conditions, the main factors of mortality was found to be casualties, starvation, and diseases. All they can be dead-causing either directly or through the starvation. Nevertheless, these causes of mortality are operative mostly not single but in interdependence on one another. The mortality caused initially by the intraspecific fight occur only exceptionally.

The resistance of the individuals to the above listed causes of mortality is given generally by the ecological conditions of their respective Umwelt. The strongest selection pressure effects in the winter (here: January through March) when the ecological conditions are relatively very hard. Middle strong effects the selection in spring (April through June) when the ecological conditions are favourable but the birds breed what causes additive mortality, and in autumn (October through December) when the conditions are less favourable than in the spring and summer but not by a long chalk so hard as in winter. The most mild selection pressure occurs in summer (July through September) when the ecological conditions are favourable and the birds do not breed.

With the above described model of selection factors and selection pressures accord all the studied bird species, and hypothetically it can be assumed that this model is authentic for all predators which are only seldom killed by other predators.

In majority of animal species the predation belongs to one of the most important selection factors (cf. e.g. EMLEN, 1973). Yet, in the case of middle-sized predators the predation effect functioning as a selection factor is considerably limited, and it is quite absent in the case of large predators. Similar absence of predation functioning as a selection factor can be observed also in some other animal species as, for example, in large mammals which avoid predation thanks to their greatness. Also man belongs to the animals which are effected by predation either insignificantly or avoid it even entirely.

However, the influence of natural selection on animals which are little effected by predation or quite avoid it is by that time much neglected in the ecological and evolutionary literature (cf. LACK, 1954; EMLEN, 1973). The aim of the present paper is to analyze the effect of selection factors on these very animals. As the model species the following four species of Mid-European birds of prey, viz. Kestrel (*Falco tinnunculus*), Common Buzzard (*Buteo buteo*), Goshawk (*Accipiter gentilis*), and Sparrow Hawk (*Accipiter nisus*), and the following three species of Mid-European owls, viz. Barn Owl (*Tyto alba*), Long-eared Owl (*Asio otus*), and Tawny Owl (*Strix aluco*), were used.

Analyzed were the data collected by the second author during a more than 25 years long period (1951 - beginning of 1978) in the Hercyn region. The data under discussion originate from the card-index of specimens which were handed over to the preparation laboratory of the Zoological Institute of the Martin Luther University in Halle/Saale. Only those spe-

cimens were elaborated whose data of finding and cause of death were known<sup>1)</sup>. The analysis refers only to the adult birds. The young birds perishing in the year of their birth were not covered by it. Considering that with regard to the studied problems no differences between sexes were found, sex is not distinguished in this paper.

One of the most frequent mortality causes of the studied birds is man, whose responsibility for deaths ranges from 31% (Long-eared Owl) to 66% (Goshawk). The only exception is the Barn Owl where man accounts for 8,5% of deaths only. Considering the fact that this condition is unnatural, the birds killed by man were eliminated from the analysis natural conditions being thus approximately simulated.

The following analysis showed that the most important mortality causes of all the studied species are: (1) injuries, (2) starvation, (3) diseases. The injuries occur predominantly during prey hunting (cf. OLSSON, 1958; PIECHOCKI, 1954, 1975; UNLENHAUT, 1976). Only very rarely the serious injuries occur during intraspecific fights or are due to other reasons as e.g. in storms and others like that. Only rarely the injuries lead directly to death, in most cases they prevent the bird from gathering sufficient amounts of food in the result of which it dies from starvation. The starvation death can be, however, caused also directly by food shortage which occurs especially in winter months (cf. PIECHOCKI, 1980a,b; SCHNEIDER, 1977). Also the diseases seldom destroy the animals directly. In this case, too, the animals cease to be able to gather sufficient amounts of food and finally perish from hunger. Nevertheless, it is necessary to stress that in majority of cases these causes of deaths do not act separately, but are related to each other. This means that a starving bird is partly more predisposed to diseases, partly takes higher risks during hunting, increasing thus the probability of injuring itself, etc. For this reason it is not well possible to decide ecologically what in fact causes the death of the given individual, although from a clinical point of view it may be quite clear, so that no exact

<sup>1)</sup> The analysis and elaboration of results were made by the first author.

quantitative data are presented in this paper.

When the distribution of numbers of deaths during a year is followed, considerable circannual variability in mortality of the studied species is found which cannot be explained by the circannual changes in abundance of the studied species. Although the precise data are naturally influenced by the abundance fluctuation, in our case it is possible to trace for sure the general tendency of the seasonal mortality changes which is not influenced by the abundance fluctuation of the studied species.

The average course of mortality of the seven studied species of birds of prey and owls is shown in Fig. 1. (The breakdown for each species is given in Tab. 1.). The description and interpretation of the mortality course is following:

Table 1

Seasonal changes in mortality of some bird species (in % of the whole-year mortality)

species	winter	spring	summer	autumn	n
<i>Asio otus</i>	69,6	16,9	2,7	10,8	148
<i>Strix aluco</i>	41,9	23,7	10,8	23,7	93
<i>Tyto alba</i>	68,0	7,8	3,6	20,7	334
<i>Buteo buteo</i>	76,1	9,2	4,5	10,3	426
<i>Falco tinnunculus</i>	43,3	21,6	14,2	20,9	134
<i>Accipiter gentilis</i>	50,0	25,0	4,2	20,9	48
<i>Accipiter nisus</i>	71,4	10,4	1,3	16,9	77
mean/summe	60,0	16,4	5,9	17,7	1260

In winter, i.e. in January through March in this paper, the mortality of all studied species is highest, the selection pressure on the given population being thus strongest in this period. This is caused evidently by both the relatively unsui-

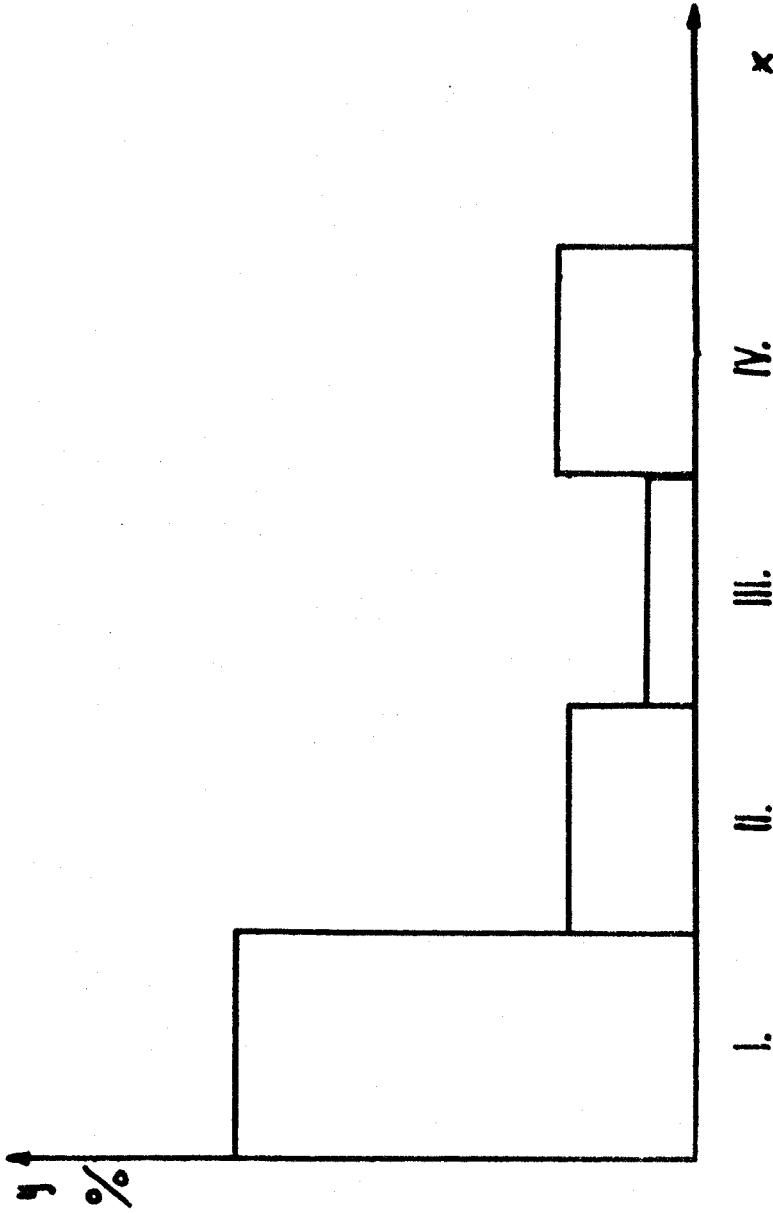


Fig. 1.: Seasonal changes in mortality of some bird species (cf. text)

x - quarters of the year

I. - winter, II. - spring, III. - summer, IV. - autumn

y - % of the whole-year mortality (cf. Tab. 1)

table climate conditions and the common food shortage (cf. GLUE, 1973).

In the next quarter of the year, i.e. in April through June, the mortality of the studied species is considerably higher than in the third (summer) quarter of the year, in spite of the fact that the survival conditions, i.e. abundance of food, favourable climate conditions and others like taht, are approximately the same in both these periods. The relatively increased mortality in the second period is caused probably by the fact that the birds are breeding in it. Effort connected with the breeding is evidently reflected in the increased mortality of the adult birds. Besides, in some years the winter conditions can outlast into the beginning of the second period thus once again increasing the average mortality of the studied species.

In the third quarter of the year, i.e. in July through September, the mortality of all the studied species is very low, so that it can be assumed that the selection effects are almost absent during that period.

In the fourth quarter of the year, i.e. in October through December, both mortality and selection pressure are nearly equal to those of the second period. The increase of mortality relatively to the previous (summer) quarter is caused evidently by deterioration of the ecological conditions, considering in the first place sufficient amount and attainability of food, and the quality of weather.

### Summary

It can thus be summarized as follows:

All the studied species of Mid-European birds of prey and owls are effected throughout the year by equal main mortality factors: (1) injuries, (2) starvation, and (3) diseases, which in species which are, more or less, not effected by predation represent the main selection factors. Their qua-

litative composition shows nearly no changes during the year but their quantity exhibits considerable variability. The selection reaches by means of them its maximum intensity during the winter months, and minimum, nearly zero intensity, during the summer months. The spring and autumn months are periods of middle strong selection effect.

With the described selection model all the studied bird species comply exactly. It is thus possible to consider hypothetically that the model is valid also for other predators which in sufficient degree avoid the effect of predation.

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