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The Effect of Weather on Density and Reproduction Success in Honey Buzzards *Pernis apivorus*

Achim Kostrzewa

INTRODUCTION

Within the last ten years ecologists have found evidence that weather conditions can affect the breeding success of different raptor species (Gargett 1977: *Aquila verreauxi*; Moss 1979, Newton 1986: *Accipiter nisus*; Ristow *et al.* 1983, Wink *et al.* 1982: *Falco eleonorae*). Some assumptions of Schubert (1977) and data from my own long-term study lead to the hypothesis that Honey Buzzards are highly dependent on weather factors during their breeding cycle (Fig. 1). This paper gives some correlations between weather and density and between weather and reproductive success.

METHODS AND AREA

Using modified methods depending on Brown (1974), we were able to ascertain all resident pairs (+/- 5%), e.g. breeders and non-breeders, in our study area. Because Honey Buzzards are difficult to find, we checked the whole raptor community (for methods and results, see Kostrzewa 1984, 1985; Kostrzewa *et al.* 1985).

The investigated area, called 'Niederrheinische Bucht', is situated near Cologne and Bonn on the west side of the river Rhine. This area covers 1,000 km^2 in a strip of 20 x 50 km. It contains 16.4% forest in different sections: (a) the old woods of the 'Ville', the 'Kottenforst' and the 'Rheinbacher Wald' (different areas of woodland from 630 - 4,575 ha); (b) the replanted area of the 'Rheinische Braunkohlengebiet' (580 - 1,720 ha), where coal is mined by the open cast system and the land is mostly planted with trees; and (c) small woods and woodlots from 5 - 120 ha of the 'Börde' on a fertile loess plain. This part is the most agricultural in our rather densely populated area (for a map see Kostrzewa 1985).

The climate has oceanic influence, with mean temperatures of 9°C and an annual precipitation of 650 mm.

RESULTS AND DISCUSSION

The population density in our area ranged between 0.8 and 1.9 pairs/100 km^2 (Fig. 2a) in different years with reproduction rates of 0.1-1.10 young fledged per pair (Fig. 2c). The population contained variable proportions of successful breeders (+BP), unsuccessful breeders (-BP) and non-breeding pairs (NRP) (Fig. 2b). In years with 'normal' weather (rainfall and temperature close to or above the long-term mean) - such as in 1979, '80 and '82 - density and reproduction were higher than in periods of poor weather (1983-85).

Fig. 1: Breeding cycle of Honey Buzzards in the study area.

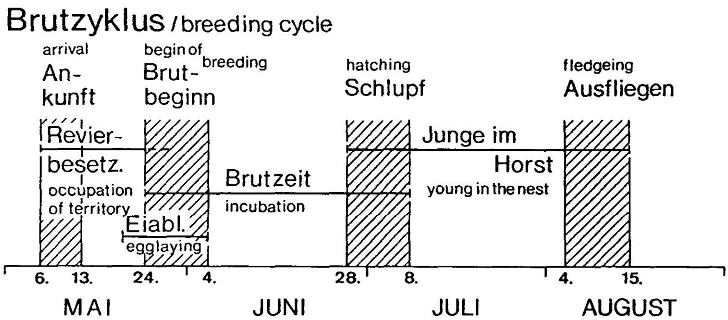
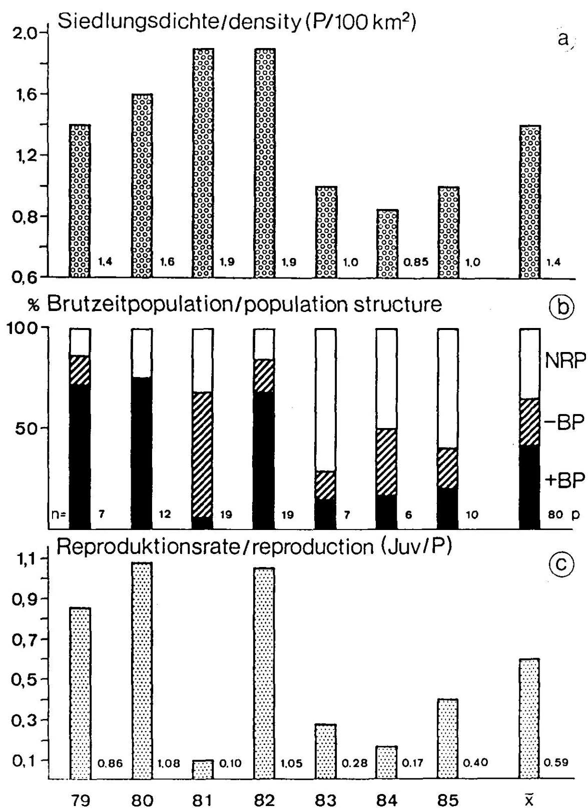


Fig. 2: (a) density, (b) population structure and (c) reproductive success of study population, 1979-85.



In 1981 there was a high density but very poor breeding success (Fig. 2c) because in May the weather was good but deteriorated in June, so that many eggs did not hatch or the young died of chilling and starvation in their first week of life.

The cause behind this variable performance could be found in weather conditions during May and June, which are important periods in the Honey Buzzard's breeding cycle (occupancy of territories and incubation, Fig. 1).

Correlations between density (Fig. 3) and breeding data (Fig.4) on the one hand and weather conditions on the other were established with Spearman's rank correlation coefficient.

In May, significant correlations between rainfall, temperature and population density were revealed (Fig. 3). This led to the idea that weather in May influenced whether Honey Buzzards established territories and started to breed. They are not able to breed later in the year, because their breeding period lasts only about 100 days (from arrival to departure on autumn migration, Fig. 1).

Honey Buzzards feed their young mostly on social wasps (*Vespidae*, see Holstein 1944, 133-134). In May, wasp colonies are small, consisting of a queen with a few workers (Kemper & Döhring 1967). Honey Buzzards could not then predict the number of wasps expected in summer, but they should be able to assess weather conditions in May which influence subsequent wasp numbers (Archer 1981). Thus we have associations between weather conditions, prey availability and breeding success of *Pernis*.

Some significant correlations between weather data and reproduction emerged in June; bad weather (especially high rainfall) linked with low numbers of successful breeding pairs ($P < 0.10$) and high numbers of non-breeders ($P < 0.10$). Pooling the data for May and June (in most years bad weather occurred in June if May was bad) gave significant correlations (Fig. 4). Bad weather was associated with high numbers of non-breeders or failed breeders, and low numbers of successful pairs with poor reproductive success. Bad weather in May and June led to chilling of eggs and starvation of young due to food shortage.

In July, no significant correlations were established, but bad weather at the beginning of this month could have had the same effect as in June - the young were then 2-3 weeks old and were still vulnerable. Only in 1980 was late July wet and this had no adverse consequences for the young.

To summarise, weather conditions were important limiting factors for both Honey Buzzards and wasps. Wasp abundance determined Honey Buzzards' breeding success, as expected from the general findings of Lack (1954). Breeding density could have been regulated in either of two ways: (1) by weather conditions alone in May, when territories are taken up; or (2) by the food supply, which is in turn influenced by weather. In the beginning of May, the adult birds arrive after a 2-3 week non-stop migration from West Africa to their breeding range in Europe. So if weather conditions are poor in May, the birds may not get enough food to produce eggs. On both hypotheses, we should find more non-breeders in cold and wet years (as I did in 1983-85, see Fig. 2), or higher densities in other parts of the breeding range where weather conditions in May are better that year. To resolve these questions, more data are needed on this rare and difficult species.

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Fig. 3: Correlations between density or number of pairs and weather conditions.

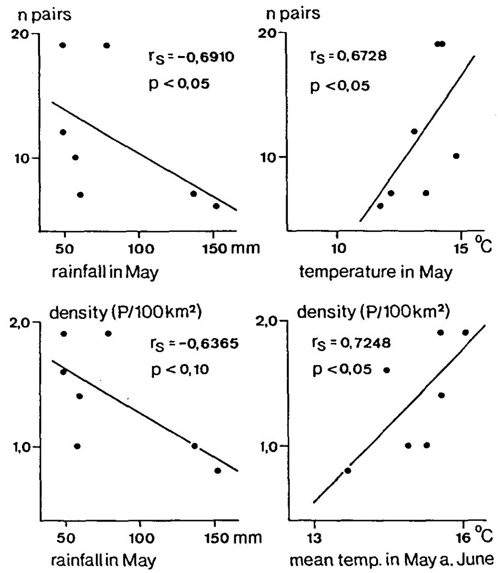
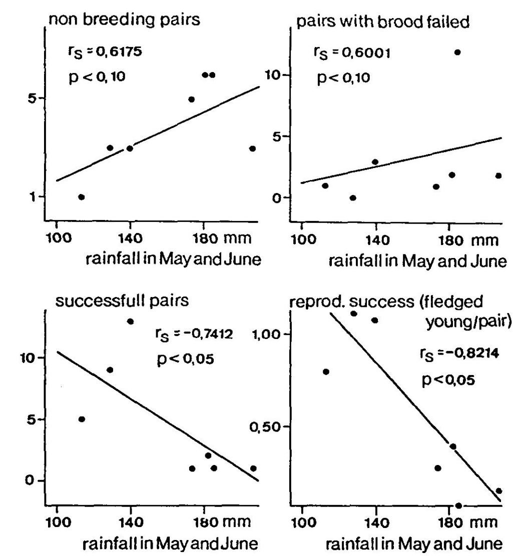


Fig. 4: Correlations between different parts of the population or their reproductive success and rainfall in May and June.



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Achim Kostrzewa
Dept. of Zoology
Univ. of Cologne
Weyertal 119
D-5000 Köln 41
Fed. Rep. of Germany