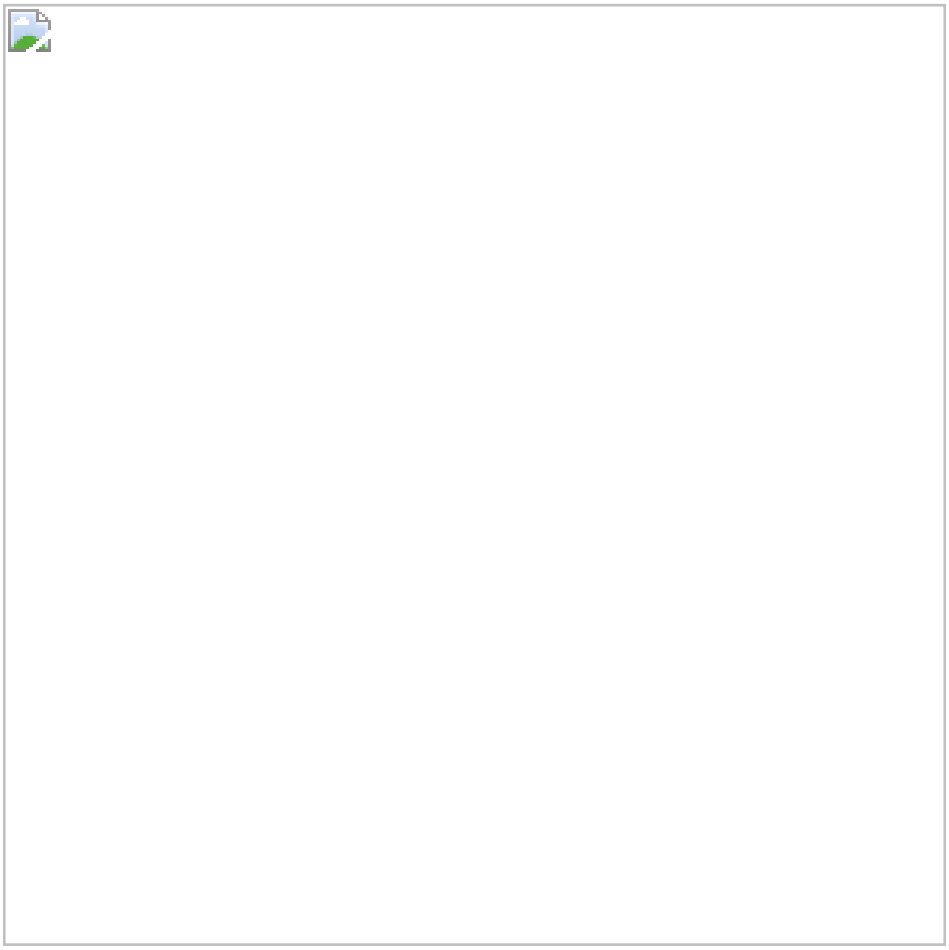

Ornithology from the Tree Tops Woodland Raptors are Declining and have Fallen Silent: Is It Pesticides, Again?

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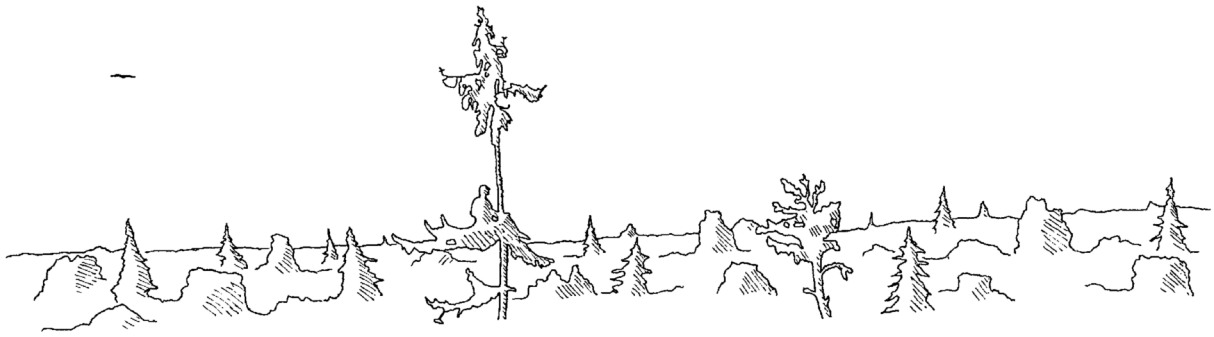

Ornithology from the tree tops

Woodland raptors are declining and have fallen silent: is it pesticides, again?

Mapping raptors on the breeding grounds was – at least till recently – rather straightforward. A systematic search of potential breeding sites in late winter and spring sufficed to locate territories and active nests within territories. The seasoned raptorphile knew where to look for nests, not a little 'facilitated' by loudly protesting territory holders. In fact, the intensity of alarm-calling informed the fieldworker how close he was to the nest.

How times have changed. Not just that many raptor species have declined in recent years, so has reproductive output. When only 50 years ago raptors were recovering from pesticide-induced crashes in the mid-20th century, and in the years to follow reached population levels higher than ever before (as far as the written record goes), the present situation is completely different. Numbers and reproduction of once common species, such as Common Kestrel *Falco tinnunculus* and Common Buzzard *Buteo buteo*, are in decline or even plummeting in many study areas monitored for half a century or longer (Looft 2017, Bijlsma 2020, Reibisch *et al.* 2021, Nielsen *et al.* 2023). Should it surprise us? Probably not, taking into account the vast changes in the European landscape, with perhaps the densely populated Netherlands (523 people/km^2) as the pinnacle of transformation.

Intriguingly, raptor behaviour at breeding sites has undergone a shift as well, to the effect that many pairs have become silent and secretive. Gone are the days that the fieldworker is greeted by furious alarm calls of parent birds near the nest. Physical and faint attacks, rare to begin with in Western Europe, have almost ceased to occur. In fact, the silence encountered whilst tramping the woodlands in search of raptor nests is rather spooky for those of us who have been at it since the late 1960s. Silent spring revisited!

Take for example the Northern Goshawk *Accipiter gentilis*, a top predator noted for its vociferous behaviour when disturbed near its nest. In the 1970s, only 80 out of 343 nest visits (23%) during various stages of the breeding cycle (from pre-laying through post-fledging) were carried out in the absence of alarm or aggression by the female. My remaining visits were accompanied by occasional alarm-calling from a distance ('distress circling', as so termed by Frances Hamerstrom 1969), frequent alarm-calling nearby or ferocious vocalizing including the occasional physical attack (the latter in 12 out of 343 nest visits). Nests visited in the same areas in the 2010s were met by silence in 200 out of 323 visits (62%), with just a single physical attack. I recorded the same shift in behaviour in European Honey Buzzard *Pernis apivorus*, Eurasian Sparrowhawk *Accipiter nisus*, Common Buzzard and Eurasian Hobby *Falco subbuteo*. The latter species is a case in point: researchers studying this species in recent decades can hardly believe the extremely vocal behaviour described for Hobbies nesting in the 1970s (Bijlsma 1980, Potters 2010, Sevink 2023). The reverse, of course, also holds: the greying raptorphile is bewildered by the present silence of nesting Hobbies. Forest-inhabiting raptors have become secretive. Consequently, monitoring is now a different game altogether.

Several striking changes in the environment were evident during the raptors' ups and downs of the past half century, namely (1) recovery, expansion and diversification of top predators since the early 1970s, (2) habitat degradation, (3) decline in quantity and quality of food resources and (4) toxic pollution of the food chain.

Habitat degradation is not just evident in farmland, but also in woodland – most certainly in The Netherlands – where steep declines of avian prey species in

Adult female Northern Goshawk on high alert in a larch some 75 m away from her nest with three chicks of 21–22 days old. The nest visit (for ringing and taking biometry) took 20 minutes, before, during and after which the female was present but completely silent (photo Rob G. Bijlsma, Forestry of Smilde, 10 June 2023).

the mass range of 75–500 g have been recorded. Many of those species depend on farmland for food, like Common Woodpigeon *Columba palumbus* and Common Starling *Sturnus vulgaris*. (The epitaph 'common' is a fair reminder of past days.) For example, in woodlands on sandy soils in The Netherlands biomass of medium-weight bird species declined by a whopping 75% or more between the 1960s and 2010s in summer, and an even larger decline occurred in winter (Bijlsma 2020). Similar trends in raptor numbers, reproductive output and prey biomass have been noted in other Western European countries, e.g. in Denmark (Nielsen *et al.* 2023) and in Germany (Müskens *et al.* 2016, Looft 2017, Reibisch *et al.* 2021). In these regions, just as in the eastern Netherlands, Common Buzzard, Eurasian Sparrowhawk and Northern Goshawk initially recovered and increased after the use of organochlorines in agriculture was banned, but all three species started to decline after the early 2000s.

Apart from reductions in food abundance, predation has become a decisive factor in raptor population dynamics, for two main reasons. The decline in main prey species forced avian predators to diversify their diets, which was associated with an increase in intraguild predation. At the same time several top predators colonized woodlands or expanded their distribution. The rise of Pine Marten *Martes martes* and Eagle Owl *Bubo bubo* did not go unnoticed, nor did the depredations by food-stressed Northern Goshawks (Bijlsma 2004). The incidence of nest predation among the smaller raptor species steeply increased, frequently in combination with the killing of one or both parents. Raiding nests and predation of medium-sized raptors (600–1000 g) used to be uncommon in the 1970s and 1980s, but this has now become an important mortality factor (Bijlsma 2020).

In the light of the above changes it is perhaps not surprising that individuals switched from high to low

profile behaviour. Remarkably, however, intraguild predation is high for silent ánd vocal raptor pairs, at least in my Dutch study areas, suggesting that a behavioural switch towards a more silent and covert lifestyle is no guarantee for nest survival (contra studies elsewhere, e.g. Rebollo *et al.* 2017). This inevitably makes you wonder whether there may be another reason for the silencing of Dutch woodland raptors, one linked to pollutants in the food chain. Already in the mid-1960s, during the onset of pesticide-induced crashes, Frances Hamerstrom (1969) noted several behavioural anomalies among her Northern Harrier *Circus hudsonius* population in Wisconsin. Especially in 1965, when she located very few nests despite the presence of normal numbers of potential breeders, she recorded not a single instance of sky dancing, and food transfers were atypically clumsy. Although she lacked hard evidence, her suggestion was that the harriers had become contaminated with pesticides (in 1965, vole numbers were low and the harriers had switched to feeding on birds), and that this 'poisoning' affected the harriers' behaviour and reproductive performance. Recent studies now provide ample evidence that she probably made a valid inference. In fact, present-day reality is far worse than she, or Rachel Carson for that matter, could have imagined. The systematic poisoning of land, water and air negatively affects physiology (blood chemistry, nervous, endocrine and immune system, telomeres, brain), life-history traits and behaviour (Sánchez-Bayo *et al.* 2013, Moreau *et al.* 2022). Experiments have shown that even low doses of neurotoxins alter behaviour (Eng *et al.* 2017), not to mention the finding that raptors had considerable higher concentrations of chemicals in their livers than prey species in their muscle tissue, suggesting bioaccumulation at higher trophic levels (Gkotsis *et al.* 2022).

Perhaps our attention should focus more on the deleterious effects of the toxic cocktail of pesticides used in industry, agriculture and horticulture (Sánchez-Bayo *et al.* 2013, Moreau *et al.* 2022, Murray & Cox 2023). It's not just raptors that suffer. The entire food chain is contaminated, leading to chemically induced changes in behaviour and survival of each and every organism.

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