Diet and Breeding Success of Eagle Owl in Southeastern Spain: Effect of Rabbit Haemorrhagic Disease

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Rabbits (Oryctolagus cuniculus) are the main prey for many predators in European Mediterranean ecosystems including Eagle Owls (Bubo bubo) (Delibes and Hiraldo 1981, Rogers et al. 1994), but how changes in rabbit populations affect the diet and reproductive success of predators has been poorly studied (Viñuela and Veiga 1992). In areas where rabbits are scarce, Eagle Owls have been reported to prey on small mammals, especially rodents (Donázar et al. 1989).

Since 1988, a new viral disease, rabbit hemorrhagic disease (RHD), has affected rabbit populations in the Mediterranean area (Villafuerte et al. 1995). While the epizootic has been shown to affect the breeding success of Golden Eagles (Aquila chrysaetos) (Fernández 1993) and red foxes (Vulpes vulpes) (Villafuerte et al. 1996), little information is available on its effects on Eagle Owls. Disease (RHD), has affected rabbit populations in the...
Table 1. Annual changes in breeding success of the Eagle Owl before (1987-88) and after (1989-91) rabbit haemorrhagic disease (RHD).

<table>
<thead>
<tr>
<th>YEAR</th>
<th>PAIRS</th>
<th>VACANT TERRITORIES</th>
<th>LAYING PAIRS</th>
<th>SUCCESSFUL PAIRS</th>
<th>PRODUCTIVITY</th>
<th>FLEDGING SUCCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before RHD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1987</td>
<td>19</td>
<td>0</td>
<td>12</td>
<td>11</td>
<td>1.57</td>
<td>2.72</td>
</tr>
<tr>
<td>1988</td>
<td>19</td>
<td>0</td>
<td>17</td>
<td>14</td>
<td>2.36</td>
<td>3.21</td>
</tr>
<tr>
<td>After RHD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1989</td>
<td>17</td>
<td>0</td>
<td>7</td>
<td>7</td>
<td>0.94</td>
<td>2.28</td>
</tr>
<tr>
<td>1990</td>
<td>8</td>
<td>11</td>
<td>5</td>
<td>5</td>
<td>1.12</td>
<td>1.80</td>
</tr>
<tr>
<td>1991</td>
<td>9</td>
<td>10</td>
<td>8</td>
<td>8</td>
<td>1.55</td>
<td>1.75</td>
</tr>
</tbody>
</table>

RESULTS AND DISCUSSION

After the RHD epidemic, both the brood size and young fledged per breeding pair decreased significantly \( (H = 0.5942, P = 0.0034 \text{ and } H = 25.6471, P < 0.001, \text{ respectively}) \) (Table 1). The number of laying pairs and the number of successful pairs after RHD did not show significant variation. Before the occurrence of RHD, all the Eagle Owl nesting territories were regularly occupied whereas, after RHD, there was a significant decrease in occupancy \( (\chi^2 = 18.74, P < 0.001) \).

Rabbits were the main prey consumed by Eagle Owls during the overall period analyzed, but after the RHD outbreak, the proportion of rabbits in the diet decreased slightly \( (\text{from } 55.97\% \text{ to } 53.64\%) \) (Table 2). Also, the proportion of alternative prey \( (\text{e.g., } \textit{Rattus spp.}) \) in the diet before and after RHD did not differ significantly \( (\text{from } 15.75\% \text{ to } 24.49\%) \). However, after RHD the proportion of pigeons \( (\textit{Columba spp.}) \) and other mammals in the diet decreased significantly \( (H = 4.0102, P = 0.0441 \text{ and } H = 12.1708, P < 0.001, \text{ respectively}) \).

After the outbreak of RHD, rabbits remained the principal prey of Eagle Owls despite the crash in rabbit densities and the fact that consumption of alternative prey species did not increase. Our findings differed from those of Fernández (1993) and Mañosa (1994) who found dietary shifts following the decrease in the rabbit population caused by the viral haemorrhagic disease. The owls in our study may not have shown a functional response switching prey species because there was an increase in the availability of sick rabbits in spring and summer and/or alternative prey species were not available. Several authors have suggested that diseases such as RHD and myxomatosis facilitate the capture of rabbits by predators (Vifiuela and Veiga 1992, Fernández

Table 2. Comparison of the diet of Eagle Owls before and after rabbit haemorrhagic disease (RHD). The number \( (N) \) and proportions \( (%) \) of prey found in pellets as well as the Kruskal-Wallis statistic \( (H) \) are indicated.

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td></td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Mammals</td>
<td>1078</td>
<td>80.4</td>
<td>592</td>
<td>86.3</td>
<td></td>
<td>0.0494 (NS)¹</td>
<td></td>
</tr>
<tr>
<td>Rabbits</td>
<td>750</td>
<td>56.0</td>
<td>368</td>
<td>53.6</td>
<td></td>
<td>2.4214 (NS)</td>
<td></td>
</tr>
<tr>
<td>Rats</td>
<td>211</td>
<td>15.7</td>
<td>168</td>
<td>24.5</td>
<td></td>
<td>2.2171 (NS)</td>
<td></td>
</tr>
<tr>
<td>Small mammals</td>
<td>24</td>
<td>1.8</td>
<td>8</td>
<td>1.2</td>
<td></td>
<td>3.1598 (NS)</td>
<td></td>
</tr>
<tr>
<td>Hedgehogs</td>
<td>79</td>
<td>5.9</td>
<td>47</td>
<td>6.8</td>
<td></td>
<td>12.1708***</td>
<td></td>
</tr>
<tr>
<td>Other mammals</td>
<td>14</td>
<td>1.0</td>
<td>1</td>
<td>0.1</td>
<td></td>
<td>12.1708***</td>
<td></td>
</tr>
<tr>
<td>Birds</td>
<td>262</td>
<td>19.5</td>
<td>94</td>
<td>13.7</td>
<td></td>
<td>0.6753 (NS)</td>
<td></td>
</tr>
<tr>
<td>Galliformes</td>
<td>41</td>
<td>3.1</td>
<td>17</td>
<td>2.5</td>
<td></td>
<td>4.010²</td>
<td></td>
</tr>
<tr>
<td>Columbidae</td>
<td>41</td>
<td>3.1</td>
<td>10</td>
<td>1.5</td>
<td></td>
<td>1.7138 (NS)</td>
<td></td>
</tr>
<tr>
<td>Corvidae</td>
<td>27</td>
<td>2.0</td>
<td>7</td>
<td>1.0</td>
<td></td>
<td>0.5346 (NS)</td>
<td></td>
</tr>
<tr>
<td>Birds of prey</td>
<td>40</td>
<td>3.0</td>
<td>19</td>
<td>2.8</td>
<td></td>
<td>1.8100 (NS)</td>
<td></td>
</tr>
<tr>
<td>Other birds</td>
<td>113</td>
<td>8.4</td>
<td>41</td>
<td>6.0</td>
<td></td>
<td>1.8100 (NS)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1340</td>
<td></td>
<td>686</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹ NS = not significant; ² P < 0.05; *** P < 0.001.
Nesting productivity decreased after RHD indicating that the crash in the rabbit population negatively affected the breeding success of Eagle Owls. Sharp declines in food resources during the breeding season have a marked negative influence on the breeding success of predators (Steenhof and Kochert 1988, Fernández 1993, Villafuerte et al. 1996, Steenhof et al. 1997), especially if the predator cannot find alternative prey (Korpimäki et al. 1990). After RHD, the number of territorial pairs laying eggs and the number of laying pairs that were successful were lower indicating that the decrease in rabbits negatively affected the fecundity of Eagle Owls. Several authors have suggested that rabbit availability determines the number of pairs of Eagle Owls that begin breeding (Olsson 1979, Mikkola 1983, Donázar 1990, Serrano 2001); nevertheless, it was clear from our findings that this species can still breed when its main prey decreases. However, we are unclear as to the minimum rabbit density which causes Eagle Owls to cease breeding.

We found that the number of occupied nesting territories after RHD decreased by 50%, probably due to the virtual disappearance of rabbits. Our findings concurred with previous studies that have found rabbit scarcity to have caused the extinction of Eagle Owls in Mediterranean localities (Donázar and Ceballos 1984, Serrano 1998). Nevertheless, they contrasted with numerous other studies which found that most species of raptors remain on nesting territories but do not lay eggs during periods of low prey abundance (Southern 1970, Saurola 1989, Fernández 1993, Steenhof et al. 1997). Because pairs can continue to occupy territories but not start breeding during periods of low prey density making their presence difficult to detect, we may have failed to locate some pairs that continued to occupy nesting territories after RHD. Consequently, our comments should be taken cautiously.

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RESUMEN.—Estudiamos el efecto de la neumonía vírica del Conejo (NHV) sobre la dieta y el éxito reproductor en una población de Búho Real (Bubo bubo) del sureste de España. El conejo (Oryctolagus cuniculus) y las ratas (Rattus spp.) fueron las presas más importantes en la dieta. Después de la neumonía hemorrágica del conejo, no se observaron cambios en el consumo de conejo y ratas. La proporción de conejo en la dieta del Búho Real no fue afectada por el cambio de densidad de conejo, quizás debido a la mayor accesibilidad de los individuos enfermos durante la epizootia. La drástica reducción de las poblaciones de conejo condujo a una fuerte disminución de la productividad y la tasa de vuelo del Búho Real. El número de parejas reproductoras disminuyó drásticamente después de la NHV, y la mayoría de las parejas no fueron detectadas. Suspechamos que este hecho pudiera estar relacionado con el abandono de las zonas de nidificación por parte del Búho Real, debido a la fuerte disminución de la población de conejo y a una simultánea escasez de presas alternativas.

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LITERATURE CITED


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