

## Some differences in the breeding ecology of *Alectoris* and *Perdix* partridges and implications for the conservation of *Alectoris*: a review

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**Abstract** – The main drivers of *Perdix* population dynamics are nest predation and the supply of insects determining chick survival rates. There is much less information about these factors in *Alectoris* but the position could be similar with nest predation clearly important and at least doubling the percentage of nests lost. Although insects comprise a smaller proportion of the diet of chicks in *Alectoris*, the number eaten is virtually the same as in *Perdix*. It is therefore to be hoped that future research focuses on these factors hitherto neglected in *Alectoris*, especially where an experimental approach can be taken.

**Key-words:** *Alectoris*, *Perdix*, nest predation, supply of insects, chick survival.

### INTRODUCTION

Major research programs on the grey partridge (*Perdix perdix*) began in the early 1930s with more than 3,000 papers in the scientific literature at the present time when there is more research literature on the grey partridge than on all *Alectoris* species combined. There has been very little research on the Daurian (*P. dauuricae*) and Tibetan (*P. hodgsoniae*) partridges and so in this paper *Perdix* means grey partridge. In the 1970s research got under way on *Alectoris*, with papers almost entirely about the red-legged (*Alectoris rufa*), rock (*A. graeca*) and chukar (*A. chukar*) partridges; with much less known about the other four *Alectoris* species. To improve sample sizes for comparative purposes in this paper *A. rufa*, *A. graeca* and *A. chukar* have been combined as one. This is partly justified because the three can hybridise to an extent that they are sometimes considered to comprise a super-species group but the main reason is because they have similar diets and parasites where they live in the same habitats; a similarity even found even in comparisons between *Perdix* and *Alectoris* partridges where they too live in the same habitats, for example in Kazakhstan and in areas where they have been successfully introduced in the north-western USA (Potts 2012). There are substantial differences between the two genera but they are largely behavioural (detailed examples

are in Potts 2012), for example in the double-brooding that occurs only in *Alectoris* partridges in which some females may start a second clutch (incubated by the female) before the first is finished (incubated by the male) (Green 1984). Summarising the work on the *Perdix* partridges I find two factors to be of overwhelming importance in their population dynamics; nest predation and the availability of insects for small chicks. We do not know whether this also applies to the *Alectoris* partridges because at this point too little research has been done. This paper summarises what is known.

### RESULTS

#### Nest Predation

I have extracted information about nest losses from 23 investigations [13 *rufa*; 7 *chukar*, 2 *graeca* and one *rufa x graeca* hybrid]. The 1,918 nests found in these studies is less than 7% of the number of *Perdix* nests found. Moreover, unlike in *Perdix* there have been no relevant controlled and replicated experiments although two studies include a comparison between areas with and without predator control. Without experiments there can be no verifiable definition of the efficiency of predator control and without radio-tracking predation can often be confused with deser-

tion. This is because incubating birds that desert can only be proven to have deserted if they are known to be alive and well. Nevertheless a picture emerges from the data shown in Tab. 1 which is very similar to that in *Perdix*.

Nest losses in areas where there was no dedicated gamekeeper averaged  $59 \pm 4\%$  with  $47 \pm 7\%$  lost due to known predation. The comparable figures in areas with gamekeepers were  $30 \pm 6\%$  and  $26 \pm 6\%$  respectively (means are  $\pm$  SE). The differences in nest losses are statistically significant ( $t=5.61$ ,  $P<0.001$ ), but the proportion of these losses that were attributable to predation was similar whether or not predators were controlled. The presence of gamekeepers controlling predators halved nest losses, but there may be much more to it than that, judging by the situation with *Perdix*.

Increases in hatching success also reduce repeat nest-

ing (with lower clutch sizes) and so increases brood sizes at hatching. Even more important is the relationship between hatching success and nest density. Whether density dependent nest predation occurs in *Alectoris* is not known, yet it could be of crucial importance. Indeed it is more likely in *Alectoris* for a given density of pairs because double brooding can increase nest density by up to 1.75 times (Potts 2012). In the Red-legged Partridge which does not cover its eggs during the laying period a validated population simulation model considered nest losses four times as sensitive to nest density as in the grey partridge (Potts 1980). This remains to be verified. In the meantime, verified or not a 29% (59-30) increase in nesting success with 1.75 broods per pair amounts to a 50% increase in the number of broods per pair with predator control.

Only controlled experiments would really clarify the

**Table 1.** *Alectoris* partridges: Studies of nest losses from nests found. Data from reared and released birds have been excluded so far as possible, as have reports involving twelve or fewer nests. Losses on areas with dedicated gamekeepers controlling partridge predators are indicated \*.

† The Mayfield correction increases the obtained rate of nest losses but re-nesting decreases the rate of nest loss of nests. In the grey partridge this correction (e.g. for nests not found at the start of laying) cancels out the correction for re-nesting (after failure; Potts 2012).

Site and species	Period of study inclusive	Nests found	Percent clutches lost	Percent clutches predated	Authority
England (Red)	1933-35	86	8	8	Middleton (1936)*
Hampshire (Red)	1953-54	18	22	?	Jenkins (1957)*
Bulgaria (Chukar)	1953-56	35	54	?	Georgiev (1958)
California (Chukar)	1954-55	17	75	45	Harper <i>et al.</i> (1958)
Washington (Chukar)	1958-60	24	75	75	Mackie & Buechner (1963)
Sussex (Red)	1969	49	41	29	Author (Sussex study)*
Israel (Chukar)	1970-71	37	68	?	Alkon (1983)
Kazakhstan (Chukar)	1974-78	76	45	25	Grachev (1983)
West France (Red)	1977-85	362	68	24	Brun (1991)
Portugal (Red)	1978	17	59	18	Bugalho & Lopes (1979)*
Spain (Red)	1978	21	29	?	Stenheil <i>in litt.</i> *
Norfolk (Red)	1980-81	78	22	22*	Green (1982) Mayfield correction reversed†
			69	69	
Spain (Red)	1982-83	33	?	49	Coll in Puga <i>et al.</i> (2002)
Spain Guedea (Red)	1982-84	606	15	15	Llandres & Otero (1985)*
Hampshire (Red)	1984-87	65	62	41	Rands (1988)*
		32	41	41*	
S France (Red)	1986-89	29	79	79	Ricci <i>et al.</i> (1990)
France (Red x Rock natural hybrid)	1986-88	14	57	43	Bernard-Laurent (1990)
Western Greece (Rock)	1998-01	32	72	69	Manios <i>et al.</i> (2007)
Greece (Rock)	<1991	33	40	?	Thomaidis <i>et al.</i> (1992)
Idaho (Chukar)	1995-96	23	59	45	Lindbloom <i>et al.</i> (2003)
Spain Malaga (Red)	1996-97	111	?	21	in Puga <i>et al.</i> (2002)
Oregon (Chukar)	1997-98	23	49	?	Walter (2002)
La Mancha Spain (Red)	2003-05	97	64	27	Casas & Viñuela (2010)
<b>Total</b>		<b>1918</b>			

situation but in the meantime, considering the above, nest predation should be regarded at least as important in *Alectoris* as it has been shown to be in *Perdix*.

#### Importance of insects in the food of *Alectoris* chicks

The diet of more than 1,500 grey partridge chicks has been analysed (Potts 2012). Many recent studies have been based on examination of fragments in faeces but here only the crop and gizzard content analyses are considered. This leaves 15 studies of chicks of approximate known age; 11 of grey partridge (Ford *et al.* 1938, Janda 1959, Georgiev 1955, Bud'nichenko 1965, Oko 1963, Poyarkov 1955, Southwood & Cross 1969, Thonon 1974, Launay 1975, Serre & Birkan 1985 and the author's Sussex study) and 4 of *Alectoris* (Georgiev 1963, Rueda *et al.* 1993; Sussex study, and work by the author in Portugal). *Alectoris* chicks ate more food, plant and animal, than Grey Partridge chicks, which is to be expected given they are 43% heavier.

Importantly however there was considerable similarity in the numbers of insects eaten by chicks of similar age (Fig 1.).

The chicks of *Alectoris* accumulate grit much quicker than *Perdix* (Potts 2012) and this helps their chicks to utilise more green plant food at an early age (Green 1984, Green *et al.* 1987). Where vegetation is desiccated, as it often is in Mediterranean summers, insects could provide

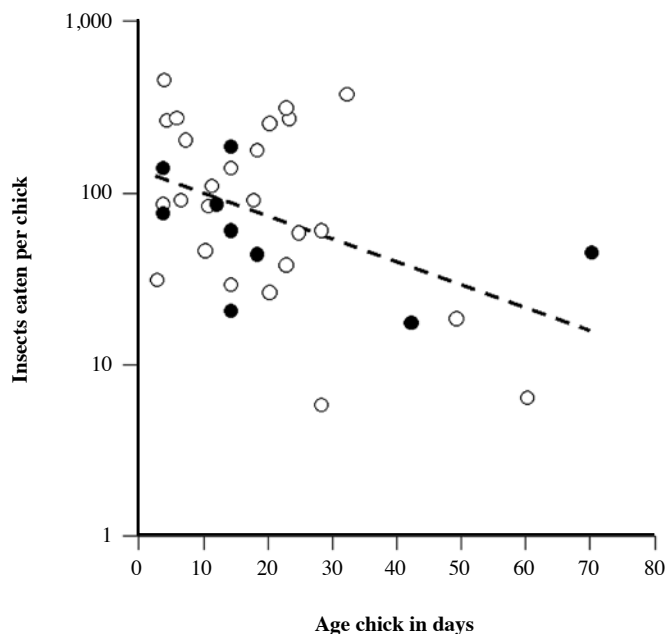
*Alectoris* chicks with much nutrition and water as well as a better supply of good quality proteins and fats. After Green's work we assumed that insects were much less important to *Alectoris* Partridge chicks than they were for *Perdix* partridge chicks. Given the extreme importance of insects in determining grey partridge numbers (Potts 1986, 2012) and the similarity in the numbers of insects consumed by the two genera, I conclude that the situation in *Alectoris* should be re-investigated. Controlled experiments on farmland are needed to assess the true position, as was carried out in Britain by Rands (1986). In mountainous areas more work could be done to explore the relationships between the diet and survival rates of chicks.

#### Overall Conclusions

The role of nest predation and insect abundance in the breeding ecology of *Alectoris* partridges has been relatively neglected. Until this is reversed most aspects of the population dynamics and conservation requirements of *Alectoris* species will remain unclear.

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**Figure 1.** Number of insects eaten by chicks of *Perdix* (open shapes) and *Alectoris* (filled shapes) Partridges declines similarly with age of the chicks in both genera: literature sources in text.

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