

## Are temperature loggers useful for studying nest disturbance in Rock ptarmigan *Lagopus mutus*?

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**Abstract** - The incubation rhythms of three Rock ptarmigan hens were monitored during spring 1999, 2001 and 2002 in the eastern French Pyrenees, by placing programmable temperature data-loggers in the nests. We tried to classify incubation recesses into two groups, normal vs. atypical, in order to detect disturbance events. Incubation patterns varied noticeably between the three hens, but we could not find a clear relationship between incubation patterns and disturbance levels, defined as distance from nests to hiking paths. The only incubation parameter apparently related to nesting disturbance was the mean number of recesses per day. The highest values of two other incubation parameters (mean length of recess and mean time off the nest per day) occurred in the hen incubating the largest clutch, suggesting the possibility of an effect of energy requirements on incubation rhythm. Body condition before incubation could also have affected incubation patterns, but we did not measure it. Even if individual differences in clutch size and body condition might have explained most of the individual variation in incubation rhythm, we suggest that disturbance was perhaps an additional factor. Because the distinction between normal and atypical recesses is subjective, the number of the latter will represent at best a rough index to the level of nesting disturbance. Given that modifications in incubation rhythm related to disturbance might reduce egg or chick viability, any evaluation of the effect of nest disturbance on breeding success should include a measure of final reproductive output (i.e. ratio of number of young reared to number of adults).

### Introduction

Incubation is a critical period for birds because they lose body heat to warm the eggs, while simultaneously meeting their own energetic requirements (Drent 1975). The energetic cost of incubation to Rock ptarmigan *Lagopus mutus* hens is particularly high because males do not incubate in this species and environmental conditions are severe on the breeding range. This energetic cost is illustrated by the loss in body mass of incubating hens, reaching up to 30% for Rock ptarmigan (Steen and Unander 1985) and Willow ptarmigan *Lagopus lagopus* (Erikstad 1986). Disturbance during nesting may further increase energetic costs and compromise success of nests or chick survival. In recent reviews addressing disturbance in birds, most studies reported a significant negative effect on breeding success (Hockin *et al.* 1992, Götmark 1992). Effects of disturbance have often been investigated by recording reproductive parameters or escape behaviour of a species according to

different levels of nest disturbance defined in advance by the researchers (Cotter and Gratto 1992, Ingold *et al.* 1996). Unfortunately, apart from researcher-induced disturbance, the real level of disturbance of nests is rarely known. However, a quantitative estimate of disturbance would be useful, for instance in comparing the nest success rates in two areas with different intensities of human activity (e.g. disturbed by tourism vs. undisturbed, or grazed vs. ungrazed). In our study, we wished to determine if the monitoring of nest temperature during incubation could be used to detect disturbance events. This method has been employed to study the incubation rhythms of several grouse species such as Willow ptarmigan (Erikstad 1986), White-tailed ptarmigan *Lagopus leucurus* (Wiebe and Martin 1997), Capercaillie *Tetrao urogallus* and Black grouse *Tetrao tetrix* (Storaas and Wegge 1997). Our study was carried out on three nests of Rock ptarmigan, a species exhibiting low breeding success over the last ten years in France (Ellison and Léonard 1996). Although post-hatching

weather conditions are thought to be the main factor determining this low breeding success in the Pyrenees (Brenot 2000), no data are available on the potential adverse effects of disturbance on nesting. However, managers of wild lands are becoming concerned about such effects on ptarmigan populations, because recreational activities are increasing in alpine habitats.

## Methods

### Study area

The study was conducted in June and July of 1999, 2001 and 2002 on the Canigou massif (42°31' N, 2°29' E), which represents the eastern limit of the distribution of Rock ptarmigan in the French Pyrenees. The breeding habitat of the species is located on steep slopes, between altitudes ranging from 2,200 m to 2,700 m a.s.l. The area is characterized by the predominance of gneiss screes mixed with sparse alpine vegetation (*Rhododendron ferrugineum*, *Vaccinium uliginosum*, *Dryas octopetala*, *Saxifraga* sp.). At 2,150 m, mean annual temperature is 4.6°C and mean annual precipitation is 1,458 mm.

Cattle grazing occurs in the study area from June to October, but grazing pressure is very low. The study area is also a renowned tourist site, and each year about 25,000 people climb to the peak of the Canigou.

### Nest characteristics

The nests of three radio-tagged hens of Rock ptarmigan (hereafter H1, H2 and H3) were monitored, one during spring 1999, the other two during spring 2001 or 2002. Each of these hens had been marked the previous year, i.e. 27/09/98 for H1, 14/09/00 for H2 and 06/07/01 for H3. The hens were adult birds – older than 12 months – by the time of nesting. The nests were located by flushing the hens toward the end of laying.

The H1 nest numbered 4 eggs when first located on 14/06/99, and 5 eggs at the time of the second visit on 17/06. It was situated on a NE-facing slope at 2,360 m altitude, and 250 m from a heavily frequented hiking path. The H2 nest included 5 eggs when first visited on 11/06/01, and 7 on 13/06. It was located at the top of a steep NE-oriented gully, at 2,590 m, and 200 m from a heavily used hiking path. The H3 nest included 3 eggs when first visited on 18/06/02, and 5 on 20/06. It was situated on a NW-facing slope at 2,330 m, and only 6 m from the same hiking path as H2.

### Incubation monitoring

The monitoring of incubation rhythms was carried out using temperature data-loggers (model: “Stowaway”; PROSENSOR - Thermométrie industrielle – 57865

Amanvillers - France). Each logger cost 145 euros and could be used during several nesting seasons. The logger is a disk 3 cm in diameter and 1.5 cm thick, i.e. less than the size of a Rock ptarmigan egg (44 mm x 31 mm : Cramp and Simmons 1980). Loggers were placed in the nest bowls, in the same position as the eggs. However, to prevent the hen from removing the logger from the nest, the logger was firmly fixed to the ground. The fastening system allowed a certain mobility of the logger in the midst of the eggs so that the temperature of the logger remained consistent with that of the eggs. This logger also enabled us, via an infra red optical reader, to program the date of the first recording and also the interval between two temperature recordings. We chose a 3-min interval, like Wiebe and Martin (1997) for their study of the incubation rhythm of White-tailed ptarmigan.

For H1, the logger was placed on the second day of incubation (17/06/99) and for H2 one day before the start of incubation (13/06/01). These second visits resulted in a further disturbance only for hen H1, H2 being off the nest. For H3, the logger was placed at the time of first visit (18/06/02). In spring 2002, an infra red optical system placed beside the hiking path, 30 m from H3 nest, allowed us to count the number of times a hiker passed during the incubation period.

### Data Analysis

Data was recovered as ASCII files, including for each recording: date, hour and temperature to the nearest 0.01°C. For each day, we first plotted the graph of daily temperatures, and then identified on each graph the different recesses of the hens, indicated by a sharp drop in temperature (Fig. 1). For each recess, we noted the initial time, the duration of the recess and the drop in temperature (Fig. 1). We also tried to identify “atypical” recesses such as those occurring

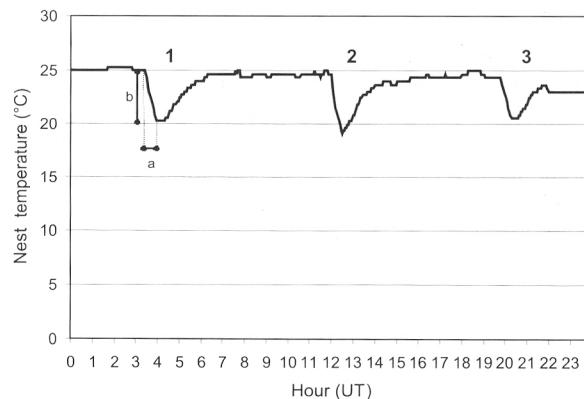


Figure 1. Graph of the daily temperatures recorded in a Rock ptarmigan nest (hen n° 2 - 17/06/01). (1, 2, 3: recess number; a: recess length; b: temperature fall).

