

Running head: Feeding schedule in male Barn Owls

Diel feeding strategy during breeding in male Barn Owls (*Tyto alba*)

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Abstract

1
2 During reproduction birds are confronted with two requirements: building up their energetic
3 reserves during the activity period, and provisioning the nest. Storing reserves imposes a higher
4 flight cost and a lower hunting efficiency. This conflict is accentuated in species such as the Barn
5 Owl (*Tyto alba*), where the nest food supply is entirely taken in charge by the male during a long
6 period (ca 37 days). We tested the prediction that Barn Owl males were postponing their meal to
7 the end of the night in order to fly with a low body mass. Nocturnal changes in body mass (i.e.,
8 estimates of feeding events) were monitored remotely on six free ranging barn owl pairs nesting
9 in eastern France using an automated weighing system. Male Barn Owls were gaining the more
10 weight at the end of the night, supporting the prediction that they make their biggest meal after
11 the nest provisioning activities hunting period that is taking place at the beginning of the night.

12
13 **Key words:** Raptors - Food intake - Body mass – Reproduction – Behaviour – Diet

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Introduction

16 During the breeding season, there is a trade-off between allocating resources to adult survival or
17 to production of offspring (Roulin, 2001; Stearns, 1992; Williams, 1966). While brooding, many
18 female raptors rely exclusively on food provisioning from males. For males, the energy cost of
19 hunting is then a very important factor affecting the trade-off between survival and reproduction.
20 To the same extent as the effect of territory quality and variations in weather (Hakkarainen et al.,
21 1997), and the duration of the female food dependence when it applies (Newton, 1979), the
22 intrinsic cost of flight is an important factor to estimate the cost of reproduction in male raptors
23 (Norberg, 1996). One of the main elements affecting the energy cost of flight is the mass that the
24 bird has to lift (Norberg, 1996). Within the same species and for a given wingspan, lighter
25 individuals have a lower cost for flight (Norberg, 1996). Indeed, the reduction in body mass has
26 been interpreted as a mechanism to reduce wing loading and optimize foraging (Sanz and
27 Moreno, 1995). Within a day, the body mass can also change greatly as a result of the timing of
28 feeding events (Durant, 2000). As a consequence, the timing of the feeding events (and its impact
29 on body mass) in relationship to the foraging activity may be an important factor in the cost of
30 flight

31 The Barn Owl, *Tyto alba* (Scopoli, 1769), is a monogamous species that commonly breed
32 in urban area in Eastern France. Barn Owls catch prey up to 2 km from the nest site with the
33 majority within 1 km (Taylor, 1994). Breeding in houses (garrets, roofs and church's towers)
34 Barn Owls have to fly over the surrounding houses to reach their nest from the hunting ground
35 carrying their prey, which may be very heavy (e.g. *Arvicola terrestris* of 120 g compared to a
36 Barn Owl mass of ca 300 g; Roulin, 2004) .The female Barn Owl usually lays clutches of 4-7

37 eggs depending on food availability (Durant, 2000; Durant et al., 2010; Muller, 1991). The female
38 starts incubation after laying the 1st egg of the clutch and stays in the nest continuously, thus
39 depending on the male for her food supply (Bunn et al., 1982; Durant et al., 2004; Shawyer, 1994;
40 Taylor, 1994) until she reinitiates foraging ca two weeks after hatching of the first egg (Durant,
41 2002; Durant et al., 2004; Taylor, 1994). In some cases of late offspring desertion by the female,
42 the male can even take care of the brood alone (Roulin, 2002). Consequently, the male Barn Owl
43 is confronted with more than one month (ca 37 days, Durant et al., 2010) of intense hunting to
44 provide prey to his mate and later on to the nestlings. Indeed, during rearing the male can deliver
45 to the nest up to 11 prey of vole size per night, which represents a cumulative mass of more than
46 80% of its body mass (ca 290 g; Durant et al., 2004). Durant et al (2004) suggested that the
47 reinitiation of foraging for the female was linked to the male food provisioning that no longer
48 matches nestling food requirements. Knowing that the survival of the last hatched chicks depends
49 on the female care and on her staying in nest to feed them (Durant et al., 2004), the hunting
50 capacity of the male has a strong influence on the reproductive success in this species.

51 The aim of the present study is to determine the feeding time of breeding males during the
52 active period (i.e., night). Our hypothesis is that due to the advantage of a lower body mass for
53 foraging (lower metabolic power required for flight, Norberg, 1996), males take their main meal at
54 the end of their period of activity (Rijnsdorp et al., 1981). If such an advantage exists, there should
55 be an energy economy associated to this behaviour. As also implicit to this hypothesis, assuming
56 that the males are fasting during their day-time rest we make a second hypothesis that they are
57 starting their hunting period by a meal. Following our first hypothesis such meal should be smaller
58 than the last one.

59 The first step to verify our hypothesis is to know when males are taking their meal and the
60 size of it. Recording eating events is notoriously difficult for nocturnal raptors, which are sensitive
61 to disturbance during breeding. We therefore investigated the timing of the body mass gains during
62 the day assuming that each mass gain is due to a feeding event. We report here the changes in body
63 mass of six free ranging male barn owls during reproduction. Data were obtained using nest boxes
64 equipped with an electronic balance and a video camera (Durant, 2000; Durant, 2002; Durant et al.,
65 2004). Body mass and activity were thus automatically recorded when males visit the nest (the male
66 was weighed once when it enters and once when it leaves the nest). With this system and
67 considering the frequency of nest visits, it was possible to precisely quantify the body mass changes
68 and calculate the mass gains. Data thus collected were analysed using nonparametric quantile
69 regression techniques on the timing of the heaviest meal of each night. The size of the meal (body
70 mass change) may, however, depend on the size of the available prey. Indeed, while a small
71 mammal specialist, Barn Owl is also an opportunist depending of the local availability within its
72 hunting territory (Mikkola, 1983; Shawyer, 1994). Our system makes it possible to identify the prey
73 delivered by the male and estimate their mass. To ascertain that the heaviest prey were available
74 during the whole activity period, and not only at the end of it, we looked at the pattern of the prey
75 mass delivered to the nest throughout the activity period. To ascertain that prey availability was
76 similar between males we investigated the prey spectrum delivered to the nest. We calculated the
77 Schoener's index on the prey delivered to the nest assuming that they represent the prey spectrum
78 available (Schoener, 1968, Mysterud, 2000).

79 Finally, the second step to verify our hypothesis is to ascertain that there is a benefit to such
80 eating behaviour, i.e., energy sparing by eating at the end of the night. We estimated the metabolic
81 power required for flight applied to three scenarios and compared the energy costs between them:

82 1 – the male eats his meal anytime during the night; 2 – the male eats his meal during two bouts,
83 one prey item at the beginning and one prey item at the end of the night; and 3 – the male eats his
84 meal at the end of the night only.

85

86

Material and Methods

87 The study was conducted in Alsace, eastern France (48°20'N, 7°45'E) on six pairs of Barn Owl
88 (hybrids of *Tyto alba alba* and *Tyto a. guttata*). The clutches were on average composed of 4.5
89 eggs (3, 5, 3, 6, 6, 4) which led to about 3.3 fledglings (3, 4, 2, 4, 4, 3). We defined an “owl-day”
90 as the period ranging from 1600 to 1559 hours the following day in order to group the foraging
91 events occurring before and after midnight within the same day. Hereafter “day” refers to an
92 “owl-day”. Days were numbered from the hatching of the last egg (day 0) in order to synchronize
93 the broods. Timing was considered in a day scale (1 hour = 0.0417 day). Nest monitoring begun
94 at the latest 27 days before the laying of the first egg (range 27-39 days) and finished 58 ± 8
95 (\pm SD) days (range 43-95) after hatching of the first egg. Moulting occurred for male Barn Owls
96 mostly after the young have fledged (July-October, Taylor 1994) and was not affecting the study.

97

Monitoring design

98
99 Data on mass and behaviour were obtained using nest boxes equipped with an electronic balance
100 located in a 1 meter long access corridor and an infrared video camera (Durant, 2002; Durant et al.,
101 2004, 2010). The system was installed in wooden nest boxes regularly used by breeding barn
102 owls. The weighing and the time of passage were recorded on a computer and the behaviour on a
103 tape recorder, both devices synchronized.

104 Sex identification was done using video identification and mass recording. The activity
105 inside the nest room was monitored by video (24h day⁻¹ recording on tape) which allows us to
106 identify differences in plumage between the male and the female during sex specific behavior
107 (copulation, egg laying, and egg incubation). Sex identification by video was confirmed by mass
108 recording. Indeed, during breeding, the female Barn Owl on average weights 33% more than the
109 male (respectively 387 g and 290g; Durant et al., 2004). During the studied period the males have
110 entered the nest on average 7.0 ± 3.3 times/day while the females did it on average 5.2 ± 3.0
111 times/day. However, the pattern of visits is not the same over time (see Fig. 1 and Durant et al.
112 2010).

113 Each time a bird walked across the weighing platform the body mass was recorded with a
114 frequency of 34 measures per sec. Due to the access corridor configuration, it takes several
115 seconds for the bird to cross it (5.65 ± 0.10 (\pm SE) s (range 0.09-42.48), $N = 9375$), body mass
116 was recorded on average 115 times during a passage. An average adult body mass for each
117 passage over the weighing platform was thus calculated using custom-made software (J. Lage
118 Jensen Software Systems).

119 The ratio of male visits to the nest with prey was 50% during incubation and increased to
120 82% after hatching (Durant et al., 2010). Males always leaved the nest without prey. The
121 weighing recorded at the exit corresponds to the male mass (hence weighing when the male cross
122 the balance without bearing a prey). The body mass gain (dBM) is the difference between two
123 consecutive male body mass measurements (exits). We assumed that a dBM increase was due to
124 food intake (overlooking the loss of mass due to pellet ejection and faeces). For the analysis we
125 only retained dBM above +10g to take into account for the accuracy of the balance. The retained
126 dBM were then associated to the time of the second exit (ranging from 0-1 with 0=1600) for the

127 analysis. Figure 2 presents the data for the six males followed (see data in Electronic
128 Supplementary Material, ESM, Fig. 4). For each owl and each day we extracted the maximum
129 body mass gain (max dBM). Further details on methods can be found in Durant (2002) and Durant
130 (2004).

131 Video recording allowed prey to be identified when delivered by the male to the nest box.
132 We classified the prey into 5 categories: "Vole" for prey of the genera *Microtus*; "Field mouse"
133 for genera *Apodemus* and *Mus*; "Arvicola" for *Arvicola*; "Shrew" for the genera *Crocidura* and
134 *Sorex*; and "Others" for birds, amphibia, insects and bats (for a total of 90, 103, 25, 21, and 145
135 items per category respectively). The mass of each prey was calculated as the difference between
136 the mass measured when the male entered with a prey and the mass measured when he exited the
137 nest without the prey (see above).

138 To ascertain that the males have access to similar prey, we have calculated the diet
139 overlap O using Schoener's index (Schoener, 1968; Mysterud, 2000):

$$140 \quad O_{jk} = 1 - 0.5 * \sum | P_{ij} - P_{ik} |$$

141 where O_{jk} is the overlap between the males j and k ; P_{ij} is the proportion of prey
142 species/group i brought to nest by male j out of the total number of prey; and P_{ik} is the proportion
143 of prey species/group i brought to nest by male k out of the total number of prey. Overlap in prey
144 spectrum brought to nest between males j and k is complete when $O_{jk} = 1$ and is absent when O_{jk}
145 $= 0$ (Mysterud, 2000).

146

147 **Density plots**

148 Density plot is a convenient method to visualize our data. With such plots it is possible to
149 visualize when during a day an event (mass change, behaviour...) is occurring the most frequently

150 and to follow this during the time period studied. We built density plots for both dBM and prey
151 mass (Fig. 3 a and b, see also ESM Fig. 6). For each day and each male, we extracted both the
152 time of the night when the bigger dBM (heaviest meal of the day) occurred and when the heaviest
153 prey was brought to the nest. Using the *kde2d* function from the R package *MASS* we obtained a
154 two-dimensional kernel density estimate (the x-axis being days and the y-axis time of the day)
155 and plotted these densities. The higher the density (i.e., more frequent is the event) the lighter is
156 the colour (white for Fig.3 and yellow for ESM Fig. 6).

157

158 **Statistical analyses**

159 Statistical analysis was conducted using the statistical package R 2.14.1 (R Development Core
160 Team, 2011). We related the change in body mass gain (dBM) with the time of the night using a
161 nonparametric quantile regression using the function *rq* implemented in the *quantreg* library
162 (Cade and Noon, 2003) and the function *bs* implemented in the *splines* library. The essence of
163 quantile regression is that the usual single-mean function estimated in a linear or nonlinear model
164 is replaced with a family of functions across a selected subset of quantiles on the interval [0, 1].
165 We tested the individual effect by adding male as factor in a Generalized Additive Model (GAM)
166 formulation as implemented in the *mgcv* library (Wood and Augustin, 2002). The individual
167 effect was not significant (mean $p > 0.648$, range 0.19-0.94) and did not add to the model
168 (Generalized Cross Validation criterium 2.847 vs 2.819 for the simpler model, see ESM Fig. 5).

169 Day-to-day changes in male body mass were estimated by linear mixed effects models
170 using the function *lmer* implemented in the *lme4* library with the male entered as random
171 variables.

172 For each male, we estimated the metabolic power required for flight using the formula
173 $P(W) = 57.3 * BM^{0.813}$ (kg) (Norberg, 1996) and the average body mass (BM). BM and P were
174 modified by the meal size eaten during the night. Meal size was estimated through the
175 metabolized energy for strigiformes ($ME = 8.630 \cdot \text{Body Mass}^{0.578}$, Wijnandts, 1984) that gives the
176 energy required by bird per day. This daily energy requirement was transformed in a mass of prey
177 required per day (assuming a prey caloric value of $7.7 \text{ kJ} \cdot \text{g}^{-1}$ and energy assimilation efficiency in
178 Barn Owl of 72.3 %; Durant et al. 2000). Following what was found for Long-eared Owl *Asio*
179 *otus* (Wijnandts, 1984), we assumed that Barn Owl males fly 3h per 24h (unevenly distributed,
180 with 2h at the beginning and 1h at the end of the hunting period). We applied 3 scenarios: 1 – the
181 male eats his meal anytime during the night; 2 – the male eats his meal during two bouts, one
182 prey item at the beginning and one prey item at the end of the night; and 3 – the male eats his
183 meal at the end of the night. The energy cost of flight was then compared between the different
184 scenarios using a paired t-test for each male after running 1000 replicates.

185

186

Results

187 The male body mass (BM) was on average 302.1 ± 0.8 g (range 287-310) during the
188 reproduction. There was a significant decrease of about 0.15 g per day (lmer: $p < 0.001$) during
189 the studied period. However, this decrease corresponded to less than 5 % of the body mass only
190 (c. -10 g over the 65 days of the study).

191 The average body mass gain (dBm) per weighing was 20.6 ± 0.4 g (range 19.7 - 21.9)
192 with a maximum mass gain ranging from 49.3 to 98.2 g (see ESM Fig. 4). Assuming that the
193 body mass gain corresponds to feeding, the size of meals was not uniformly distributed along the

194 night (white in Fig. 2 and ESM Fig. 5). Males seemed to make a small meal at the beginning of
195 the night, then a big meal at the end of the night (Fig. 3a).

196 The prey delivery spectrum was similar between males (Durant et al., 2010). On average
197 overlap of prey delivery between males was $O = 0.988 \pm 0.017$. If we consider that when overlap
198 $O > 2*SD$ of the diet overlap between males was full and highly significant. The heaviest prey
199 were delivered to the nest at the beginning of the night (Fig. 3b), independently of the prey
200 category considered (ESM Fig. 6).

201 The time and the number of meals have a significant but very small effect on the flight
202 cost. Compared to scenario 1 (1 meal anytime in the night), scenario 2 (1 meal at the beginning
203 and 1 meal at the end of the night) was significantly more costly 0.12 ± 0.01 W ($t = -13.64$, $p <$
204 0.001). Compared to scenario 1, scenario 3 (1 meal at the end of the foraging period) was
205 significantly less costly -1.59 ± 0.02 W ($t = 110.88$, $p < 0.001$).

206

207

Discussion

208 We show that during reproduction male Barn Owls, while eating throughout the night (Fig. 2),
209 tend to take their main meals at the end of the night-time and that this pattern is true during the
210 whole reproduction. Using radio-tagged males, Taylor (1994) suggested that male Barn Owls start
211 to consume prey after catching six to eight items, and that they caught all their prey during the
212 first 3 hours or so of hunting. Indeed, parent Barn Owls provision their brood mainly during the
213 first part of the night (Michelat and Giraudoux, 1992; Ritter and Görner, 1975; Roulin, 2001) and
214 thus certainly satisfy their own needs during the second part (Taylor, 1994). However, in our
215 study we show that while the heaviest meal was taken at the end of the night, males were also
216 eating at the beginning of the night. In addition, males brought prey to the nest during the whole

217 night (Fig. 3b). This behaviour would be coherent with them hunting all their prey at the
218 beginning of the night (Taylor, 1994) if the Barn Owl males caches prey outside the nest, as done
219 by the common Kestrel *Falco tinnunculus* (Masman et al., 1986). Noteworthy is the observation
220 that the males usually brought the heaviest prey to the nest at the beginning of the night. This
221 indicates that male Barn Owls have the possibility to eat bigger meals at the beginning of the
222 hunting period than they actually did and were not constrained by the size of the available prey.
223 Barn Owls being opportunist in their prey choice, this result also indicates that the males caught
224 the heaviest prey at the beginning of the night and possibly caches food outside the nest. That
225 male Barn Owls capture and deliver the heaviest prey to the nest at the beginning of the hunting
226 period could also be an answer to the hunger of the nestlings/female at this time (end of the
227 daytime rest). While this may be the case when the food requirement is at its maximum (ca 30
228 days after the hatching of the first egg; Durant et al., 2004), prior to it we often observed
229 remaining prey in the nest chamber before the delivery of its first prey by the male (Baudvin,
230 1980). Note that before 15 days of age, nestling Barn Owls cannot swallow whole prey and that
231 food is dispatched to them by the female throughout the day. Finally, while the heaviest prey were
232 delivered to the nest at the beginning of the night, the delivery frequency was not higher during
233 this period as would be expected if there was an higher incentive to the male to deliver prey
234 concomitant to the high hunting possibilities at sun-down (see below).

235 Barn Owls do not have a lot of body reserves (Handrich et al., 1993; Thouzeau et al.,
236 1999). This could be a reason why they eat throughout the night (Fig. 2). However eating big
237 meals before the high activity period could be energetically expensive (see below). As with
238 passerines, Barn Owls may be confronted to the conflict of assimilating a meal during the activity
239 period and the mass-dependent cost of flying (Thomas, 2000; Witter and Cuthill, 1993). The

240 tendency to postpone feeding to the end of the nest provisioning activity can be interpreted as a
241 strategy to optimize the body mass and thus to reduce the cost of flight. Indeed, low wing loading
242 is advantageous for very slow flight and hovering (Witter and Cuthill, 1993). Barn Owls are
243 utilizing such behaviours frequently during hunting (Taylor, 1994) and thus may be particularly
244 penalized by the increase in energetic costs associated to the increased body mass. Likewise, Barn
245 Owls catch prey up to 2 km from the nest site located in house garrets or roofs (Taylor, 1994).
246 They must carry their prey from the hunting ground and over the surrounding houses to reach
247 their nest, adding to the cost. Using an allometric relation between body mass and power
248 necessary to fly, we show that there is indeed a significant energy saving by feeding after the
249 hunting period. This behaviour was also observed in passerines that often feed their young most
250 intensely early in the day (e.g. House Sparrow *Passer domesticus* (O'Connor, 1984) that is
251 consistent with the view that the parents are reducing the impact of mass-dependent costs by
252 foraging most intensely when their body mass is low.

253 The Barn Owl is specialised towards hunting micro-mammals such as field mice
254 (*Apodemus spp*) and voles (*Microtus spp*) (Durant et al., 2010; Frey et al., 2011; Mikkola, 1983).
255 However, the Barn Owl is also an opportunist which bases its hunting on the profitability of the
256 prey (Ille, 1991) and captures species according to their availability. In nature, the period of hunt
257 for the barn owl depends on the diel cycle of their prey. In eastern France, the main prey
258 composing the diet of Barn Owl is the common vole (*Microtus arvalis*, (Durant et al., 2010). For
259 microtine rodents, the most prominent activity peaks of the day commonly occur at dusk and
260 dawn (see Halle, 1993). During reproduction, the barn owl hunts the most at the beginning of the
261 night (Taylor, 1994). The advantage of eating at the end of the night is then double. It allows it to
262 concentrate on hunting when food is highly available, and to do it with a lower flying cost

263 (reduced wing loading, Norberg, 1996). Reduction of wind loading has already been hypothesized
264 as a mechanism used to reduce the cost of foraging (Sanz and Moreno, 1995) during breeding,
265 notably for the female (Durant et al., 2004). However, this hypothesis has been used to explain
266 the body mass change during the entire reproduction period due to a spontaneous decrease of the
267 food consumption. Here we show, as suggested for passerines (Thomas, 2000), that this
268 hypothesis can be used to explain the diel regulation of body mass.

269 Many previous studies have found that the body mass of birds shows a diel cycle with
270 minima at the beginning of the activity period and maxima at the end (e.g. Blem, 1976; Evans,
271 1969; Haftorn, 1989, 1992; Kontgiannis, 1967; Stuebe and Ketterson, 1982; Thomas, 2000). Our
272 study supports the idea that birds attempt to regulate their body reserves within a single day. This
273 result is of interest as it provides evidence for the first time of how small raptors are strategically
274 regulating their food intake to match the energy requirement and mass-dependent costs. Our
275 results provides another example that the reduction of the body mass is not necessary linked to a
276 cost or a negative energy budget. In our study the body mass decrease seemed to be linked to an
277 optimisation of the energy budget and not to an increase of the male Barn Owl's energy
278 requirement.

279
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288

289 **Electronic supplementary material.** The online version of this article contains supplementary
290 material, which is available to authorized users.

291

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372

373 **FIGURE LEGENDS**

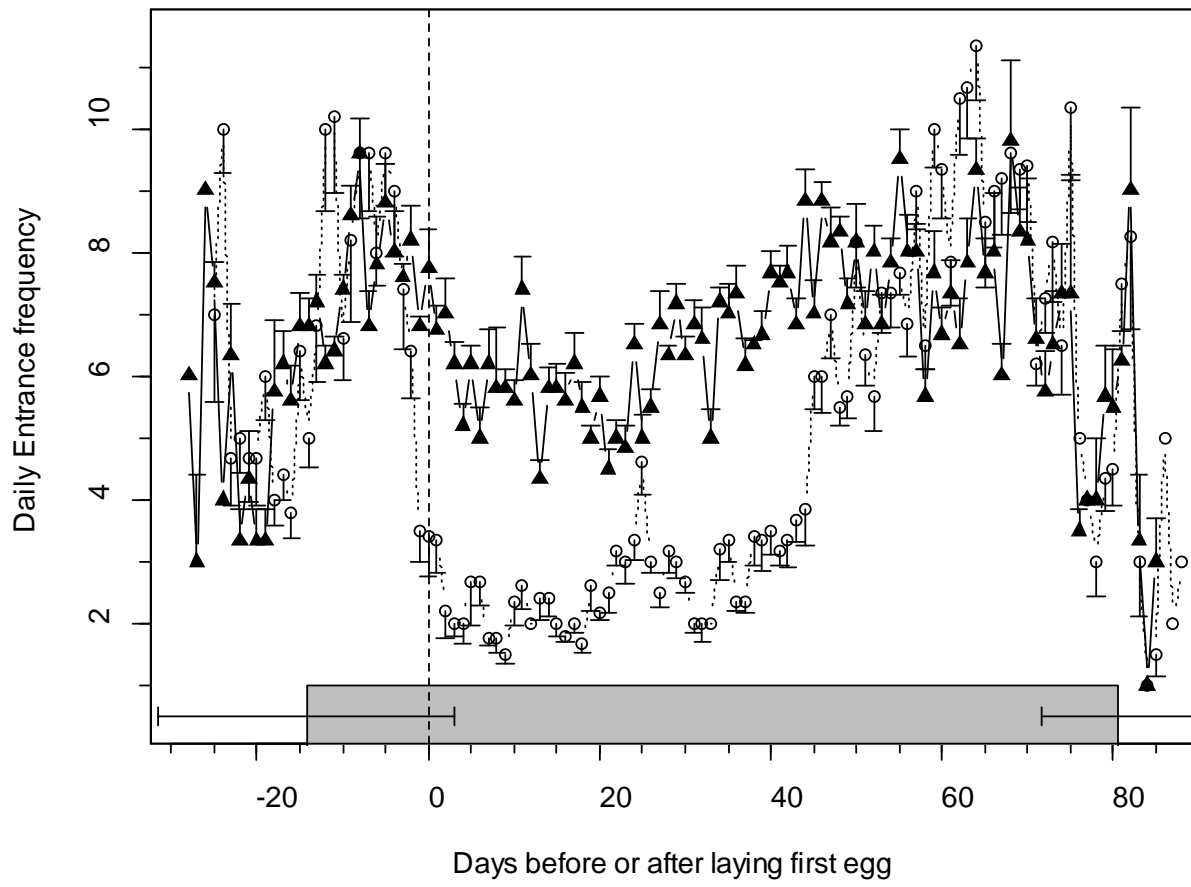
374 **Fig. 1.** Mean daily number of entries of six Barn Owl (*Tyto alba*) breeding pairs to the nest
375 (males are *filled triangles* connected by *solid line* while females are *open dots* connected by
376 *dotted line*). The shade area corresponds to the period used for the analysis. The vertical *error*
377 *bars* are \pm SE and horizontal ones \pm SD.

378
379 **Fig. 2.** Body mass gain of male Barn Owls during the night. Each dot represents the increase of
380 mass for a male measured between two weightings and is assumed to correspond to the food
381 intake during the same period. The fitted nonparametric quantile regression every 0.1 quantile is
382 presented in lines. The thick line is the 0.5 quantile. Lines over the 0.5 quantile are quantile 0.6,
383 0.7, 0.8 and 0.9 and under the 0.5 quantile are quantile 0.4, 0.3, 0.2 and 0.1.

384
385 **Fig. 3.** Density plots displaying the males feeding habit (**a.** time when the heaviest meal of the
386 day (max dBM) is more frequently taken) and prey delivery (**b.** the time when the heaviest prey of
387 the day is more frequently brought to the nest) throughout the breeding season. Lighter is the
388 colour (i.e., white) higher is the frequency of the event. The 2 hatched areas are daytime. **a.** The
389 male behaviour seemed to change 2 times, first around hatching of the first egg (first dotted
390 vertical line), and second at the female first exit (second dotted vertical line). **b.** The heaviest prey
391 of a day are more often brought to the nest at the beginning of the night (hence caught at this
392 time). After the first hatching (day 0) some heavy prey are brought at the end of the night.

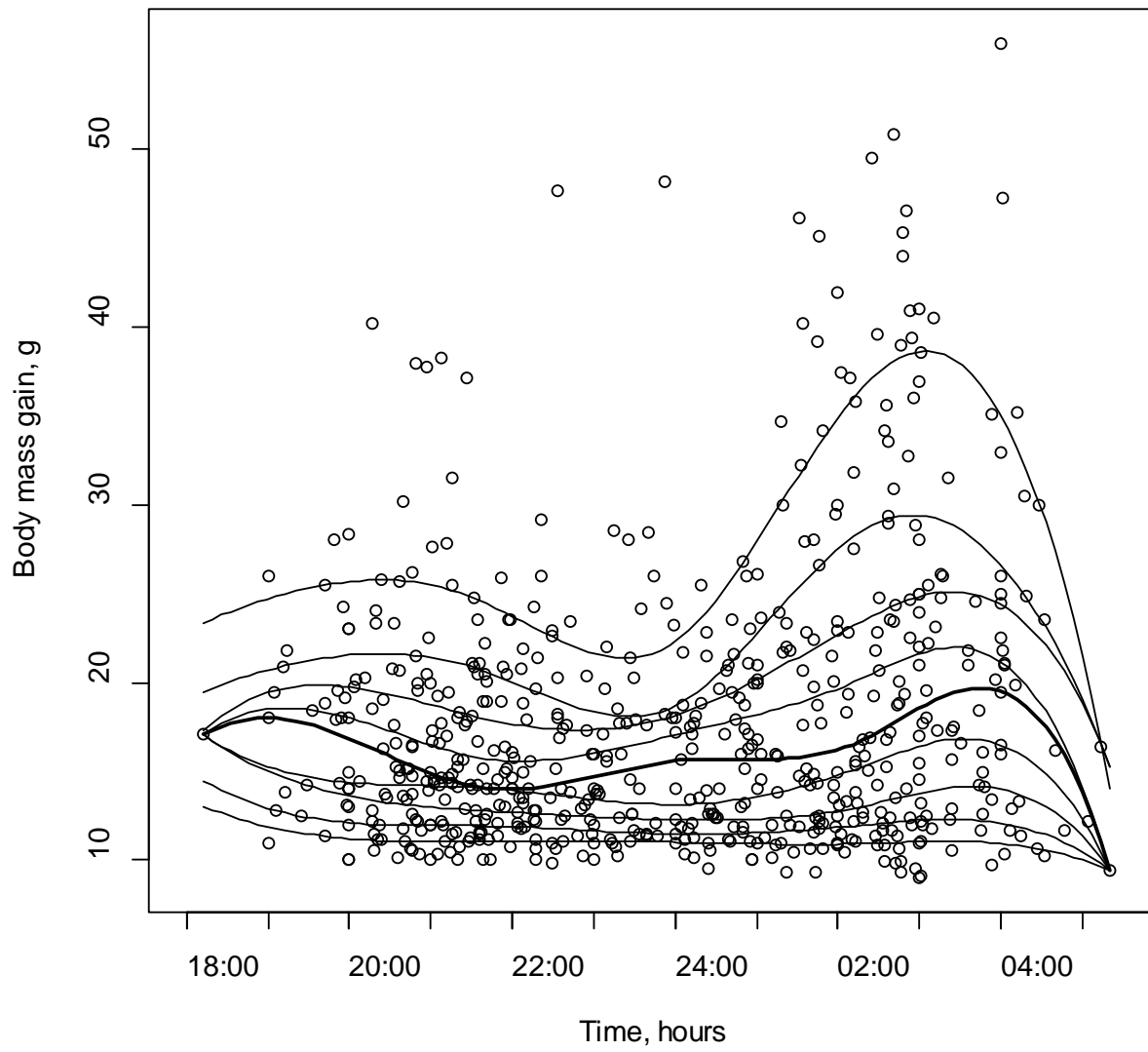
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394 Figure 1



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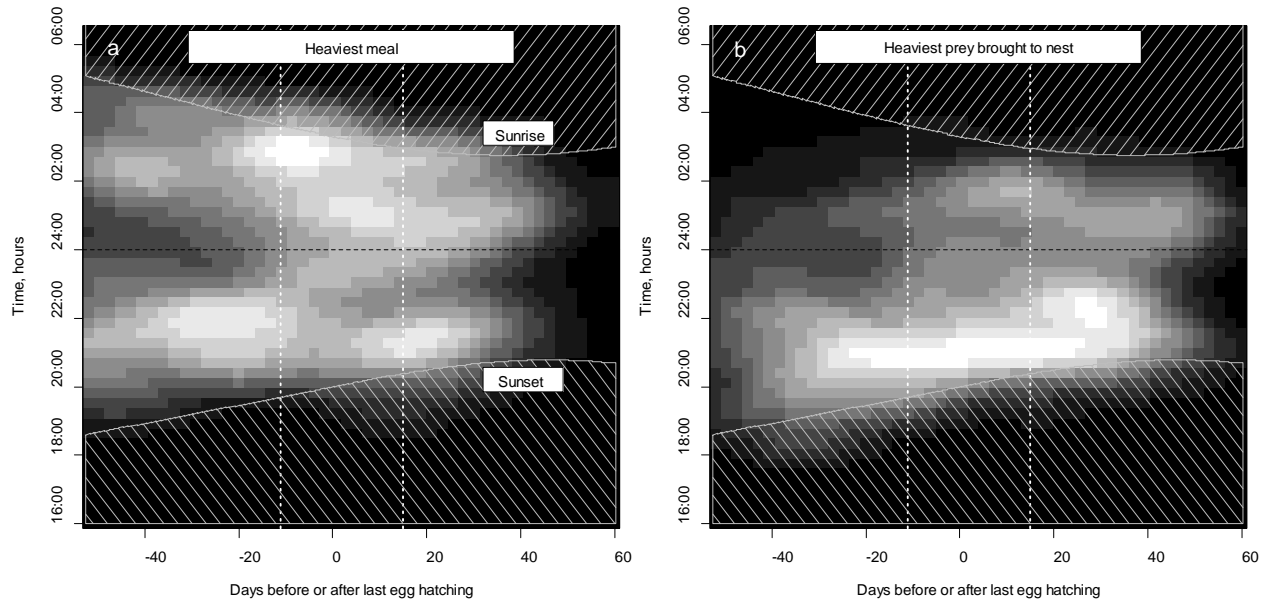
396 Figure 2



397

398

399 Figure 3



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401

402 **SUPPLEMENTARY MATERIAL**

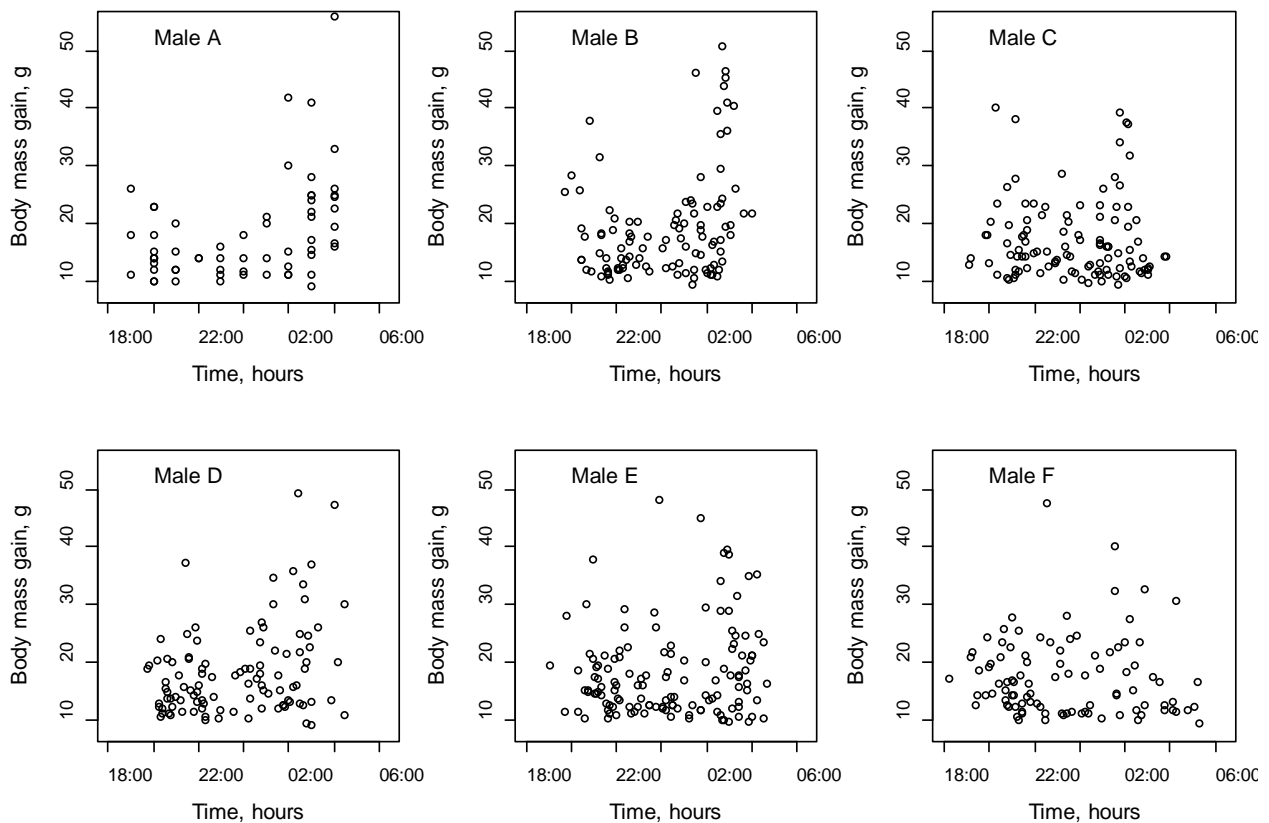
403

404 **Diel feeding strategy during breeding in male Barn Owls (*Tyto alba*)**

405

406 Joël M. Durant, Dag Ø. Hjermmann and Yves Handrich

407 **Supplementary figure 4: Body mass gain of male Barn Owls**



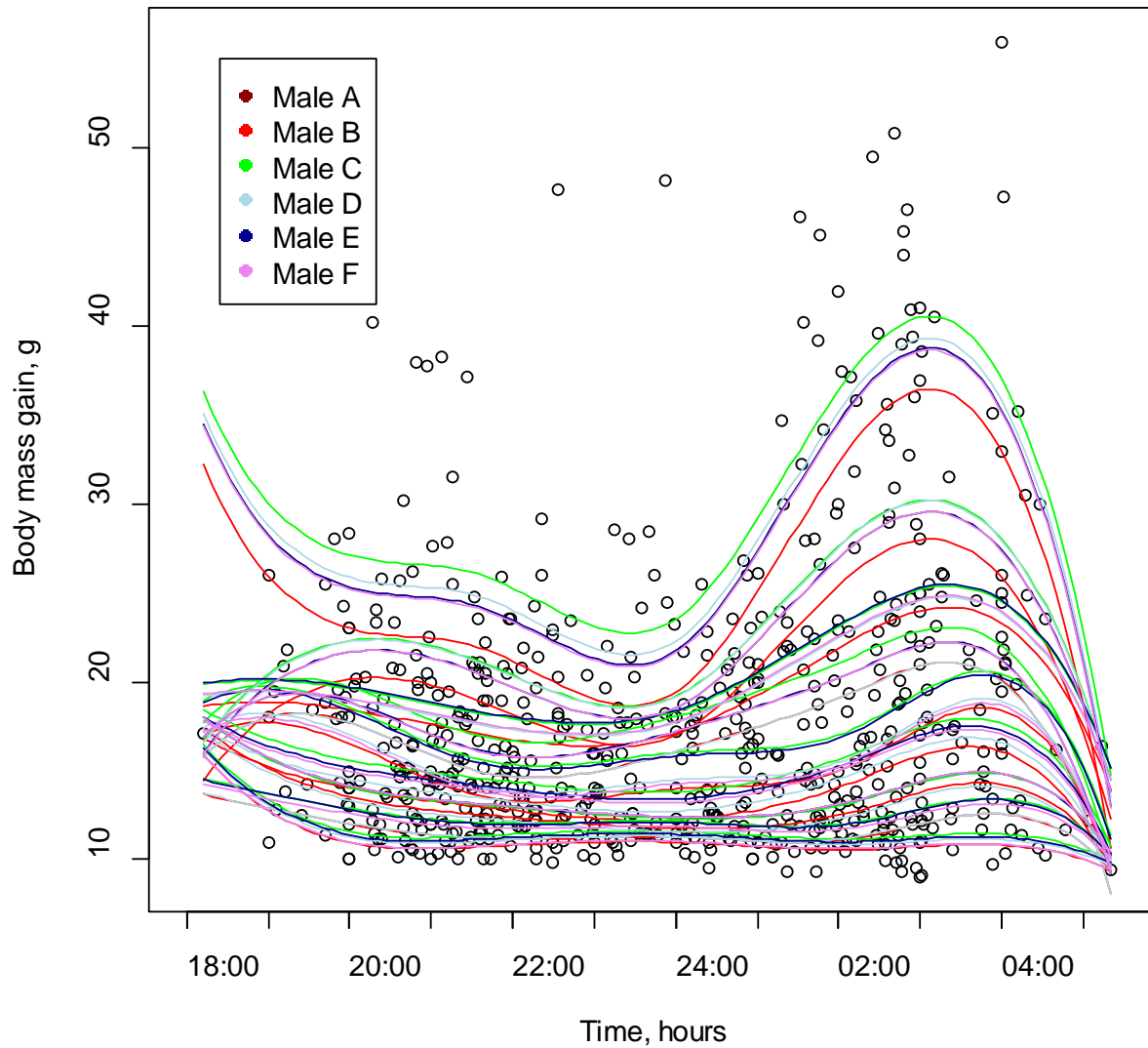
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410 **Figure 4.** Body mass gains of male Barn Owls during the night. Each dot represents the increase
411 of mass for a male measured between two weightings and is assumed to correspond to the food
412 intake during the same period.

413

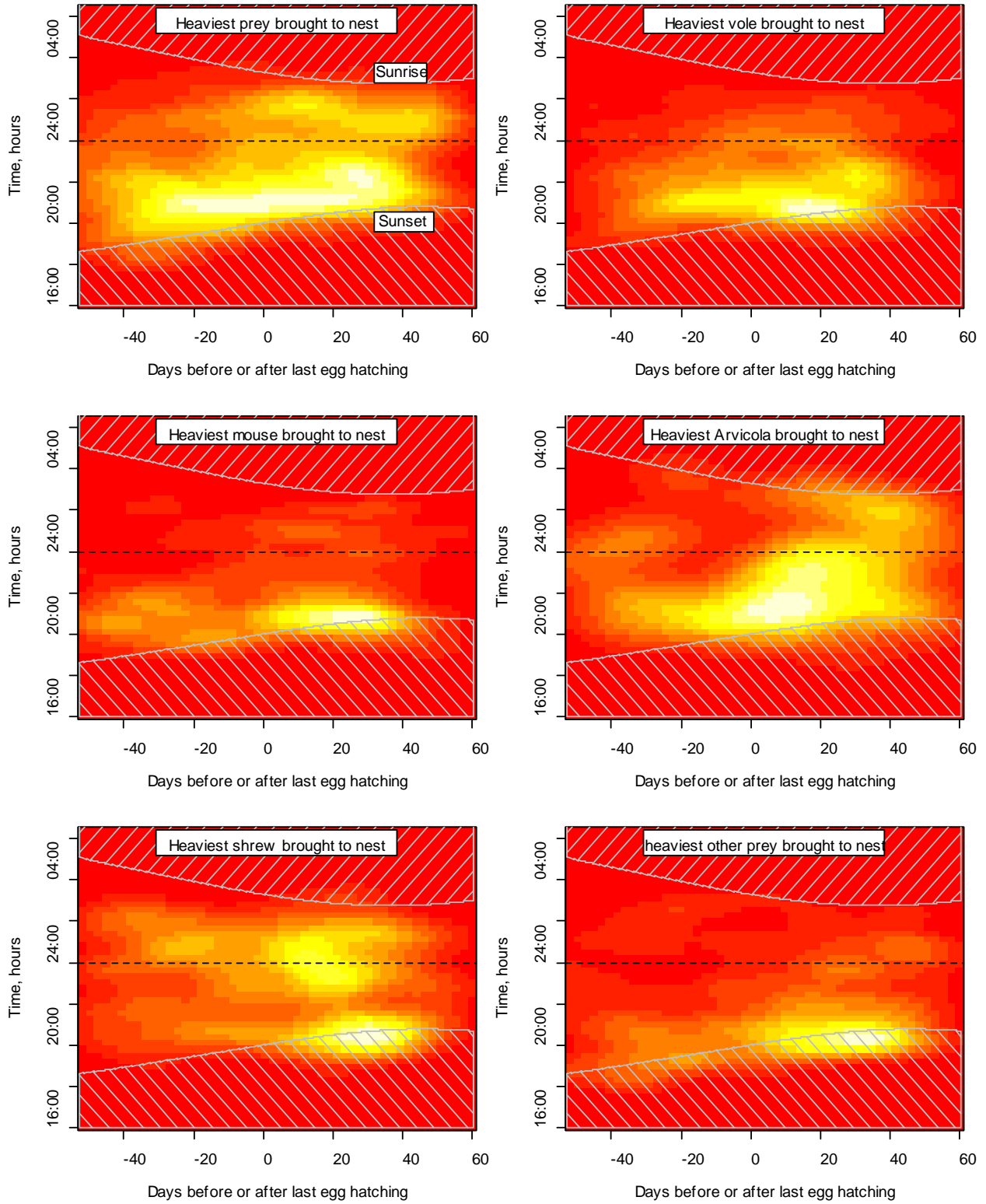
414 **Supplementary figure 5: quantile regression analysis**



415
 416
 417 **Figure 5.** Body mass gain of male Barn Owls during the night. Each dot represents the increase
 418 of mass for a male measured between two weightings and is assumed to correspond to the food
 419 intake during the same period. The fitted nonparametric quantile regression with Male as factor
 420 variable every 0.1 quantile is presented in lines.
 421

422

Supplementary figure 6: prey delivery analysis



423

424

425

Figure 6. Density plots displaying prey delivery to the nest throughout the breeding season. Each plot presents the time when the heaviest prey of the day is more frequently delivered to the nest.

426 The density range from low (red, no event) to high frequency (yellow, many events). The 2
427 hacked areas are daytime.

428 The plot on the top left is a colour version of the Fig. 2a, i.e., all prey confounded. The heaviest
429 prey of a day are more often brought to the nest at the beginning of the night (hence caught at this
430 time). After the first hatching (day 0) some heavy prey are brought at the end of the night
431 corresponding to *Arvicola* (the heaviest species of the Barn Owl diet).

432

433

434