Barn Owl *Tyto alba*: Influence of the sibling position on survival and settlement success of the young owls.[1]

Ernst Kniprath & Susanne Stier-Kniprath

1 Introduction

As usual in many owls, Barn Owls as well mostly start incubation with the first egg. In consequence we find great differences in the development of the siblings. This fact is thought being the basis for a brood-reduction occurring still during elevation of the owlets when prey is scarce (GLUTZ VON BLOTZHEIM & BAUER 1989: 257). The term "brood-reduction" allows the interpretation that somebody would actively reduce by cannibalism (infanticide or cainism). We only know with certainty that this reduction (almost) always starts with the youngest and thus smallest sibling in a brood (EPPLE 1993). The position of each single owlet thus has a crucial meaning for its survival already as nestling. Indeed, there could be other periods of life for which this is affective as well.

2 Material

Beginning 1990 in the county Northeim in northern Germany the young Barn Owls have been ringed (KNIPRATH & STIER-KNIPRATH 2014). Thereby we strictly saw to it that ringing was done in the age-line of the young. So for each sibling the position of each sibling in that line is known. The basis of this study is the total of all broods controlled in the county Northeim. First and second broods are studied separately.

3 Results

3.1 Hatching success

Even if no sibling position can be given for the eggs without individual marking, the hatching success at least in relation to the clutch size seems to be interesting (fig. 1). Clutch size for 413 first broods had been ascertained with sufficient accuracy. In all broods, for which in the data base 1-3 is given and as well for more than half of the broods which a clutch size of 4 this number is the result of an estimation on the basis of the number of young found. These values here are not included. Concerning this figure we in addition mention that for the values of clutch sizes 4 and 11-13 the n in all cases is smaller than 6. These values as well are not used for the figure 1. There we found no dependence of the hatching success on the clutch size.

For the second broods (fig. 2), where only clutch sizes of >4 were used, a decrease of the hatching success up to clutch size 8 from 97% to 85% and later a distinct increase is visble. The majority (77,6%) 0f the clutches belonged to the category clutch size 7-10.

[1] Translated from: Kniprath E & Stier-Kniprath S 2017: Schleiereule Tyto alba: Einfluss der Geschwisterposition auf Überleben und Ansiedlungserfolg der Jungeulen. Eulen-Rundblick 67: 52-56

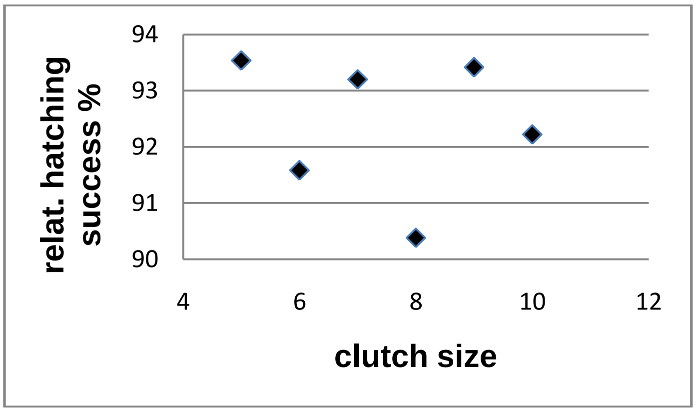

Figure 1: Hatching success of first broods in telation to clutch size (n=413)

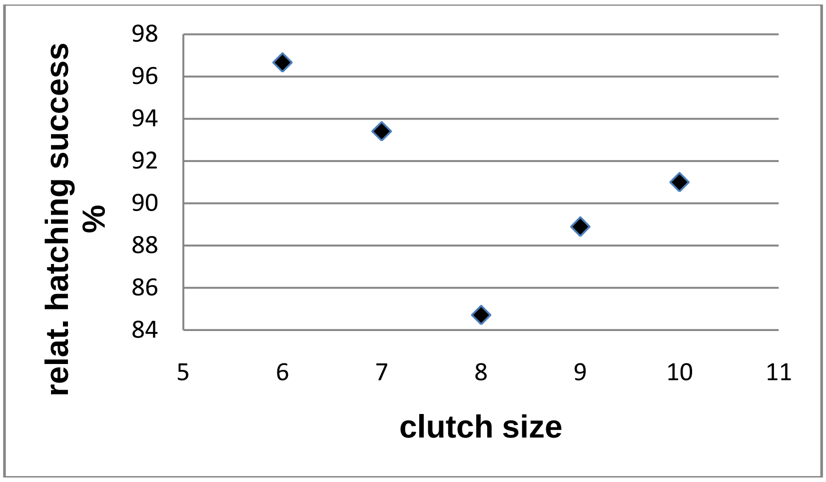

Figure 2: Hatching success of the second broods in relation to clutch size (n=66)

3.2 Losses in the nest by sibling position

Who in the file of the indeed differently old siblings is hit by death already in the nest? Within the 263 first broods with losses following the brood records, there were 13 broods, in which losses not began with the youngest sibling but with any one (or any two ones) in the sibling line. Table 1 represents in %, for which basic number of pulli (hatching numbers 3-10) how many in the line (nr. 1-9) had been lost. Figure 3 represents graphically the relations. The proceedings are really homogeneous: For the hatching numbers 3-8 (excluding 7) sibling nr. 1 never disappeared. Then the losses increased for all clutch sizes non-linearly. The development in the hatching numbers 9&10 differed markedly: The losses started only at a high sibling position. Such high numbers of siblings only are found when prey numbers are very high. Then as well the chance of the parent owls to raise a higher number of young up to fledging is better. The chance of the younger siblings narrows that of the older ones.

	hatching number							
sibling position	S 3	S 4	S 5	S 6	S 7	S 8	S 9	S 10
1	0,00	0,00	0,00	0,00	0,90	0,00	0,00	0,00
2	9,09	3,03	1,33	0,97	0,00	0,00	0,00	0,00
3	27,27	9,09	2,67	2,91	2,70	1,92	0,00	0,00

4		18,18	13,33	8,74	6,31	3,85	0,00	0,00
5			28,00	18,45	11,71	5,77	0,00	0,00
6				30,10	27,03	15,38	0,00	0,00
7					40,54	26,92	0,00	0,00
8						40,38	5,56	0,00
9							16,67	0,00
10								33,33

Table 1: Pulli-losses in % in dependence on hatching numbers and position in the sibling line for 263 first broods (only broods with losses)

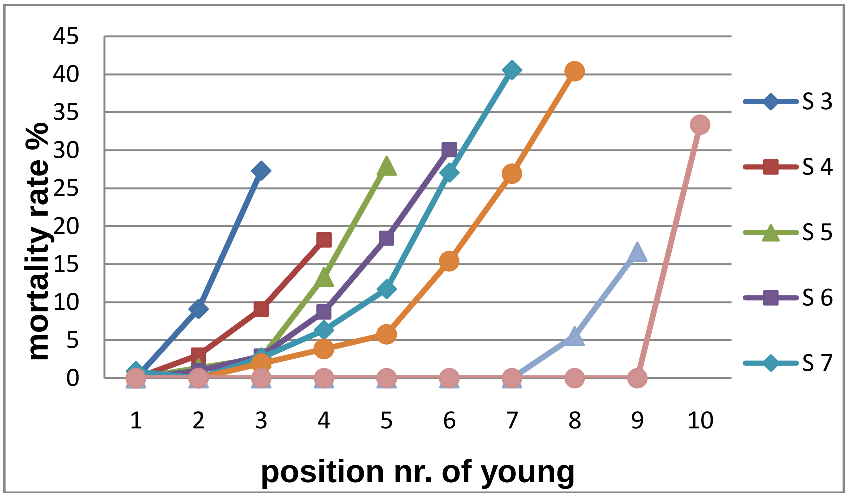

Figure 3: The pulli-losses after position in the sibling line (nr. 1-10) for the hatching numbers (S 3-10) for 263 first broods (values from table 1)

Among the 93 second broods with losses there was only one, in which the losses not started with the youngest owlet but with anyone in the sibling line. Table 2 summary represents for which starting number of pulli (hatching nr. 5-12) the losses in the sibling line (nr. 1-12) were. Figure 6 represents the relations graphically. In agreement with expectance we see that the losses only start later in the sibling line than in the first broods. Additionally it is obvious that in the broods with the higher numbers (10-12 hatchlings) the younger siblings do have inferior chances.

	hatching nr.							
Sibling-position	S 5	S 6	S 7	S 8	S 9	S 10	S 11	S 12
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	11,1	0	0	0	0	0	0
4	17	11,1	5,88	0	10	0	0	0
5	50	22,2	5,88	9,09	10	0	0	0
6		55,6	17,6	18,2	20	40	0	50
7			47,1	18,2	50	40	25	50
8				63,6	60	40	25	50
9					80	60	25	100

10						60	75	100
11							75	100
12								100

Table 2: The pulli-losses summary by hatching number and position in the sibling line in 93 second broods (only broods with losses)

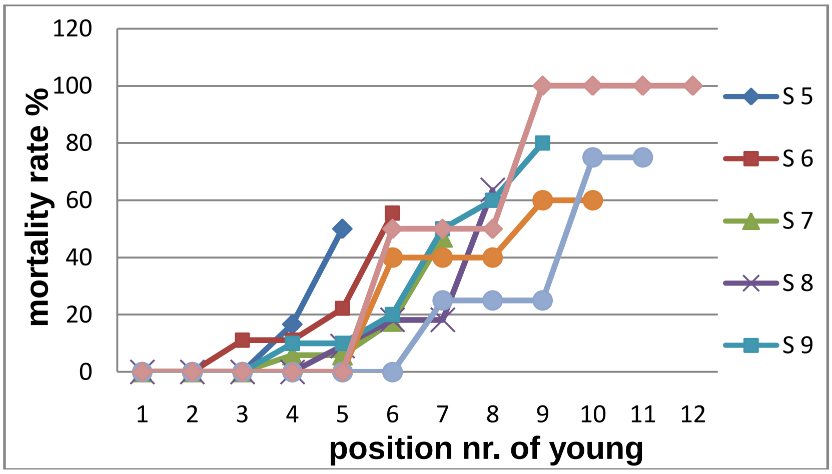

Figure 4: The pulli-losses after position in the sibling line (nr. 1-12) for the hatching numbers (S 5-12) for 93 second broods (values from table 2)

3.3 Fledging success

Here as well we first calculated the fledging success in relation to the hatching number (figs. 5 & 6). Omitting the categories 2 and 11/12 of the hatching numbers in the first broods, which each comprise only one value, no influence of the hatching numbers on the relative fledging success is visible (fig. 5). This also fits for the second broods (fig. 6), for which values with an n<3 were neglected.

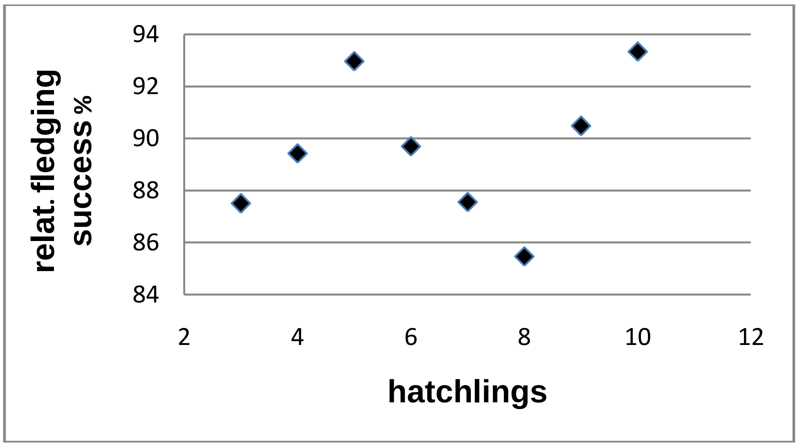

Figure 5: Fledging success of the first broods in relation to the hatching numbers (n=318; only broods with losses)

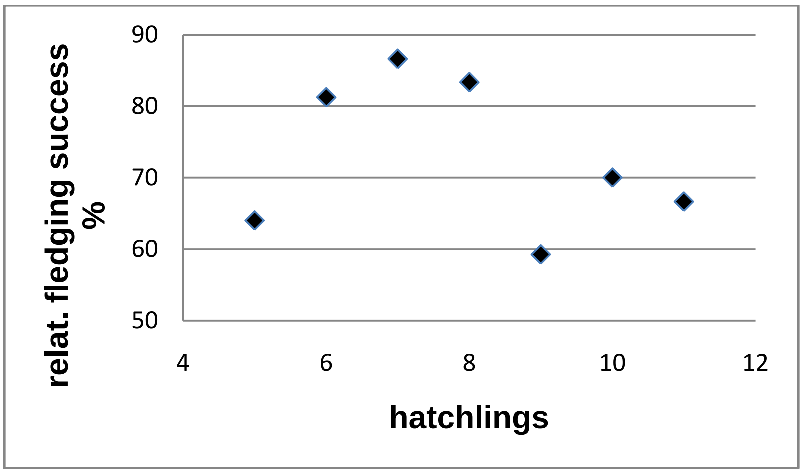

Figure 6: Fledging success of the second broods in relation to the hatching numbers (n=61; only broods with losses)

3.4 Later success by sibling position

Dispersal by sibling position

The data base contains 2,937 ringed nestling owls (included those from outside the defined study area) with known sibling position. Among these 491 (16.71%) were recovered, with 157 in a distance of >5 km (fig. 7). Showing high oscillations, the means as well as the medians (less for these) of distance increase with the sibling position. This indicates, among the younger siblings more dismigrate over higher distances than do among their elder siblings.

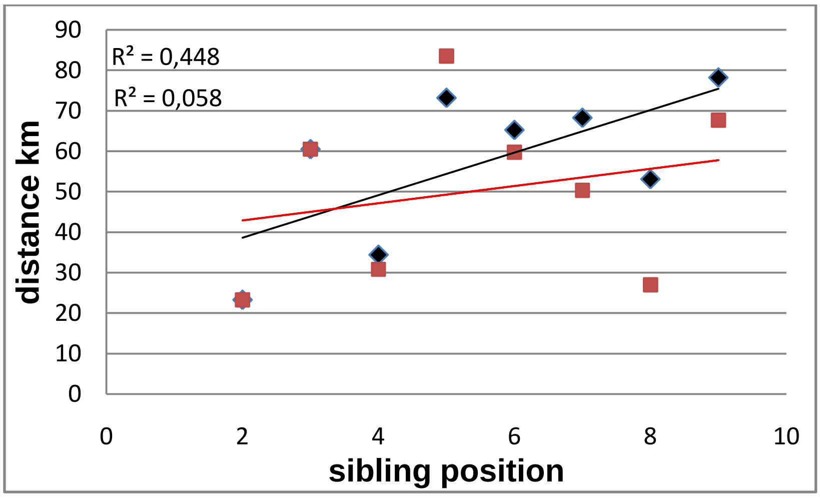

Figure 7: Recovery distances as means (black) and medians (red) by sibling position (n=157)

Settling success by sibling position

For 2,881 young owls fledged in the narrower study area (see KNIPRATH & STIER-KNIPRATH 2015) the sibling position is known. Among these 133 (4.62%) in later years were controlled as breeders in the study area. How these share among the sibling positions compared to all fledged ones is represented in figure 8. The result is clesr: Whether a young owl later could establish in the study area as breeder was not depending on its position in the sibling line. (In the opposite case the parts of breeders in the lower positions should be clearly higher.) Here we should consider that in this number ob breeders those are missing, which bread outside the study area. The higher part of breeders in the sibling positions 7&8 indicates that such numbers preferably are found in very good years, in which for the better prey situation a nearer settling is possible.

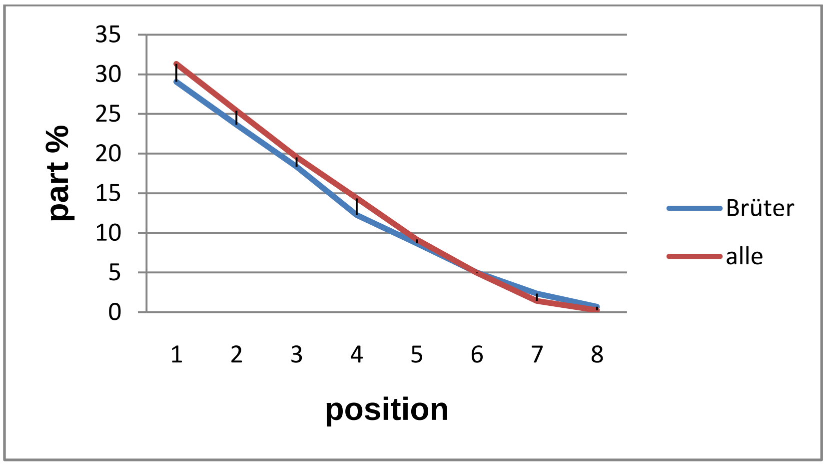

Figure 8: Parts of the owls later controlled as breeders following their position in the sibling line (n=133) compared to the distribution in all (n=2,881)

At a total different level we could ask: Could a young owl at the end of the sibling line at least sometimes escape its fate? We must begin earlier: As well known, Barn Owls are, considering size and weight, inversely sexually dimorph, the females are greater and heavier than the males (means following Mebs & Scherzinger 2000: ♂: 315 g, ♀ 340 g). We might suggest that this dimorphism does not yet exist in the egg or at hatching. It should express during growth (fig. 9). That means that female owlets normally take over a male sibling, which had hatched before them, eventually even take in a second one. If such an event happens at the end of the sibling line, a female owlet so sometimes may escape from the danger-zone (of an earlier dying during a shortage of prey) (fig. 10), as it is able to be louder in begging.

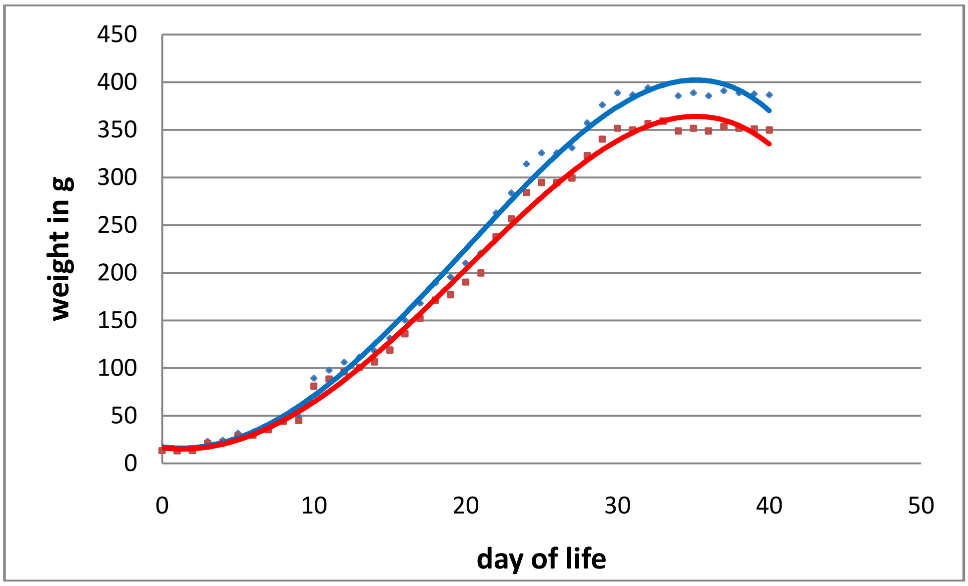

Figure 9: Growth curve of two siblings of different sex with the same hypothetic day of hatching. (data from fig. 12 in SCHÖNFELD & GIRBIG 1975, transformed under the supposition that the difference of weight at the 35. day of life should be 10%; blue: ♀)

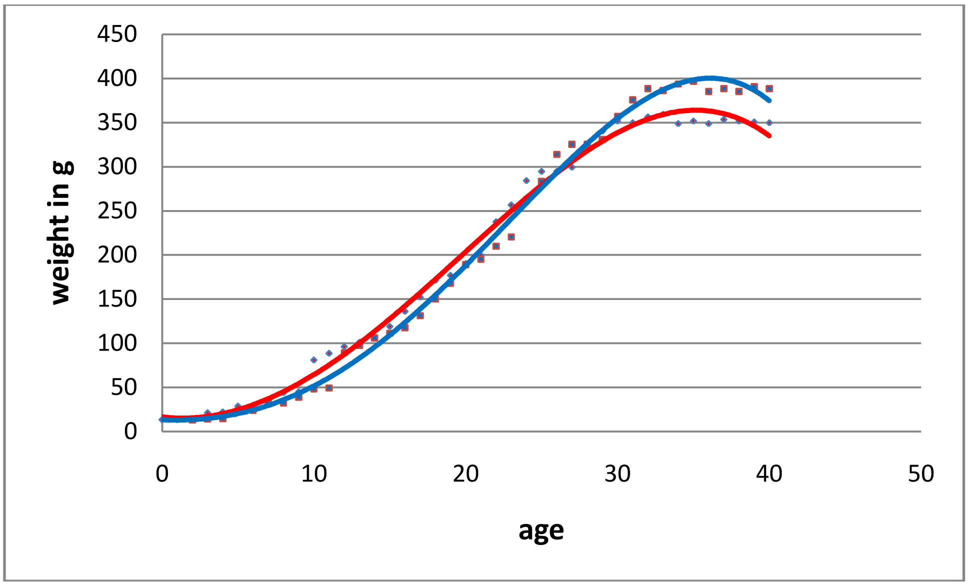

Figure 10: Growth curve of two siblings of different sex with the usual hatching interval (♂ first) of two days. (data as in fig. 9; blue: ♀)

If the development is as suggested, male Barn Owls at fledging, even if not to a greater extent and only in bad years, should be under-represented.

4 Discussion

Different from the present study, Taylor (1994: 169) has marked by age 138 eggs in 38 broods. Of these 40 (22%) did not hatch and 33 (82%) of these had been laid as the last or almost last one. So already here the discrimination of the younger siblings begins. Whether there is any relation to the prey situation, remains uncertain.

As for the hatching success there is no correlation with the clutch size (fig. 1), we could suggest that this is also valid for the second broods. The correlation visible in figure 2 is interpreted as a false correlation. It indeed could not be interpreted.

Concerning the fledging success of the first broods (fig. 3) we could – not regarding the hatching numbers 9&10, which exist only in very good prey years – come to the conclusion, the mean hatching number of 5 would have the relatively greatest elevation success. For the brood sizes >5 we indeed find an explanation: Even in normal years it is more difficult to raise seven young (93 broods) than five ones (54 broods). But why should the elevation of three (8 broods) or four (26 broods) young then should be more difficult than that of five remains unexplained. Here we only might assume that those small broods would be so small, for they had parents of lesser quality.

The data of the second broods (fig. 4) are similarly difficult to be interpreted. Why should here the elevation of five or six owlets be more difficult than that of seven, exactly inverse as in the first broods? The decrease of the values towards the greater broods then again seems to be interpretable.

For the first broods (table 1, fig. 5) and less clear for the second broods (table 2, fig. 6) the knowledge of all Barn Owl observers is confirmed that during prey shortage the youngest sibling first perish. Confirmation we also find in BAUDVIN (1978), WILSON et al. (1986: after TAYLOR 1994) and TAYLOR (1994: 174). In addition Taylor communicates detailed data concerning the dying age of the pulli for years of good and bad prey situation. Following him death reaches the majority of the pulli during the first 20 days after hatching, thus fairly early. The selection thus mostly happens during the time in which the elder siblings are in their strongest growth phase and have the greatest demand of prey.

The term “brood reduction” as used in several publications (for Example Epple 1993) on the brood biology of the Barn Owl allows the interpretation, somebody (which obviously means the parent birds of the respective brood) would reduce actively and perhaps well-planned the respective size of the brood depending on prey amount. KNIPRATH & STIER-KNIPRATH (2010) summarized, which actions and by whom really had been demonstrated in this connection and have added own observations by video in a brood in Israel. In this latter one the already reactionless youngest sibling had been dispersed by his mother (and so killed definitely) and used as fodder for his brothers and sisters. Not into this context does belong the killing of an extra-familiar owlet as described by BIRRER & HÜSLER (2003).

The dependence of the breeding success of Barn Owls from the prey offer is well established since Taylor (1994: 173). We may assume that the males, which as well known are the only providers not only of their offspring but during the breeding phase as well of their mates, thereby do their very best. The survival of a brood thus mostly is depending on the fitness of the male. There we may have in mind that this latter one certainly first tries to maintain its own fitness by a sufficient alimentation. Each other behaviour would lead to its weakening and so possibly to the total ruin of the brood. The own survival at least opens the option for a further brood in a nest breeding season. The strategy of the female would be identical. She as well must first save her own fitness for her own survival to save at least a part of her brood.

BUNN et al. (1982: 131 and EPPLE (1993: 60) pointed to the fact that in the Barn Owl not all siblings beg at a time. As we know from the experimental studies of ROULIN et al. (2000) older pulli dispute by “test-begging” during the feeding intervals, who has the greatest hunger. This sibling then continues begging. The parent bird arriving with food so obviously is influenced. Following Epple (1993: 60) he now in the arising disorder (as now all siblings beg simultaneously) straightly approaches a certain owlet and renders the prey to it. This owlet not necessarily must be in the pole position. We could assume that so the younger siblings with their naturally weaker voices are in disadvantage. This indeed only fits when the mother no more stays with her brood. It certainly seems possible that the mother, which in earlier phases of the brood continuously is present, then as well is influenced by the method of disputing described. BÜHLER (1981: 191) describes so: .... generally it depends on the intensity of the begging and jostling, in which sequence the siblings are fed.” and shortly later: “If then after the delivery of the following mouse to the female no older owlet draws at the mouse and still begging of younger siblings is heard, the female again seizes the prey with her talons and practises the known program of parcel feeding.” BRANDT & SEEBAß write: “The intensity of the begging-snoring of the young decides...”. In agreement we read the statement of Wilson et al. (1986, following Taylor 1994: 170): “In African barn owls, the young that hatched later in broods tended to gain weight less rapidly than earlier young, …” Preferring the older siblings during prey bottle necks unquestioningly has the consequence that the younger owlets are discriminated against, in the case of a lasting bottle neck will become weaker and then even may die.

The elder siblings as well do have an influence on the survival of their younger siblings. Here we do not reflect on that died pulli are consumed. This doesn’t an influence on the survival of the younger siblings but certainly it is of gain for those who consume. Just as little the sometimes described feeding of siblings by siblings (EPPLE 1979; BUNN et al. 1982: 133; DE JONG 1995: 64) has a meaning for the survival of these. They only do so, if they are satisfied themselves (BÜHLER 1981: 194, DE JONG 1995). If they didn’t render the food, they would, as satisfied themselves, simply deposit it somewhere. The younger sibling still being hungry and so continuing begging later would receive the mouse from its mother.

We here reflect to the frequently described cainism, the killing of a (younger) sibling. BÜHLER hat observed it in his captive owls (1981: 195), even if there was sufficient prey in the nest. Whether such a behaviour also exist in the wild still seems to be uncertain. At least BUNN et al. (1982: 132) have observed violent attacks of an owlet towards his sibling and attribute it to extraordinary hunger. DE JONG deduces from his observations: “Van echt kannibalisme is dus geen sprake.“ [Consequently there is no indication for real canibalism.] SCHERZINGER (1971: 498) as well has the opinion “that weakened young no more react and then are treated as deposited prey.” Here we adopt the comment of BUNN et al. (1982) that “statement in the literature [concerning cannibalism] … mostly do not reflect observations but logical conclusions”.

All that leads to the conclusion that there exists no normal behaviour of Barn Owl parents and probably as well of the siblings, which we could interpret as an active interference in the survival chances of single owlets. So we should try to introduce instead of “brood reduction” a term, which not allows such an interpretation. “(Brood-) shrinkage”, as we already can read in BRANDT & SEEBAß (1994: 122), would be more fitting.

The was the supposition that older siblings also after fledging had an advantage compared to their younger brothers and sisters as they eventually would be in a better condition at their start into independence. This on one hand could influence the distance reached at their dispersal. Following figure 7 that should be rejected: The younger siblings preferably disperse farer. Indeed preferably the elder ones reach the great distances. This of course could mean, as already discussed for the dispersal (Kniprath 2013: 44), that for the greater distances greater energy deposits are necessary. But these eventual greater deposits as well could be of advantage at the struggle for a nearer settlement. This assumption was not confirmed (fig. 8).

Obviously there exists no study of the growth speed of the pulli discriminated by sex. So the assumption, female pulli could take over a male sibling that had hatched before them today is a mere hypothesis. A study, which, as is to be hoped will follow, seems to be attractive.

Summary
Following TAYLOR clutch size in the Barn Owl already during egg stage shrinks, beginning with the egg(s) layed lastly. The relative hatching success is not depending on clutch size. During the nestling period the losses depending on the prey situation first affect the youngest siblings. Following the authors this is caused by the intensity of begging, whereby the older siblings are at an advantage. Following TAYLOR death largely hits the pulli at an age up to 20 days.

Neither cainism nor cronism play a role at the shrinkage of the broods. These events are rare and in addition not happen before the pulli don't show normal reactions any more or already are dead. As there obviously is no influence of the parents or of the elder siblings on the survival of the younger ones, the term in use "brood reduction" is refused as being misleading. "Shrinkage" is neutral.

When dispersing, the younger siblings reach slightly greater distances. The success in settling within the respective study area is not dependant on the position in the sibling row.

We propose the hypothesis that a younger, female pullus could take over its older, male sibling during the growth-process and so eventually escape an early death by starvation.

Literature
BAUDVIN H 1978: Les causes d'échec des nichées de chouette effraie (*Tyto alba*). Le Jean-le-Blanc 17: 29-34
BRANDT T & SEEBAß C 1994: Die Schleiereule. Aula Wiesbaden
BÜHLER P 1981: Das Fütterungsverhalten der Schleiereule Tyto alba. Ökol. Vögel 3: 183-202
BUNN DS, WARBURTON AB & WILSON RDS 1982: The Barn Owl. Poyser, Calton
DE JONG J 1995: De Kerkuil en andere in Nederland voorkomende uilen. Friese Pers Boekereij Leeuwarden
EPPLE W 1979: Geschwisterfütterung bei jungen Schleiereulen *Tyto alba*. J. Ornithol. 120: 226
EPPLE W 1993: Schleiereulen. G. Braun Karlsruhe

GLUTZ VON BLOTZHEIM U & BAUER K 1994: Handbuch der Vögel Mitteleuropas 9, 2. Aufl., Aula Wiesbaden
KLEIN A, NAGY T, CSÖRGÖ T & MÁTICS R 2007: Exterior nest-boxes may negatively affect Barn Owl *Tyto alba* survival: an ecological trap. Bird Cons. Int. 17: 263-271
KNIPRATH E 2013: Die Wanderung nestjung beringter, norddeutscher Schleiereulen Tyto alba nach dem Material der Vogelwarte Helgoland – Teil 2. Eulen-Rundblick 63: 30-46
KNIPRATH E & STIER-KNIPRATH S 2010: Schleiereulen *Tyto alba*: Jungvogel an Geschwister verfüttert. Eulen-Rundblick 60: 66-68
KNIPRATH E & STIER-KNIPRATH S 2014: Schleiereule *Tyto alba*: Eigenschaften und Bruterfolg einer zweiten niedersächsischen Population. Eulen-Rundblick 64: 43-65
MEBS T & SCHERZINGER W 2000: Die Eulen Europas. Kosmos
ROULIN A, KÖLLIKER M & RICHNER H 2000: Barn owl (*Tyto alba*) siblings vocally negociate resources. Proc. R. Soc. London B 267: 459-463
TAYLOR I 1994: Barn Owls. Predator - prey relationships and conservation. Cambridge Univ. Press
WILSON RT, WILSON MP & DURKIN JW 1986: Breeding biology of the barn owl *Tyto alba* in central Mali. Ibis 128: 81-90

Dr. Ernst Kniprath
ernst.kniprath@ageulen.de