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Tests of Boxes for Bats

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With 1 Figure

Boxes have turned out to be a valuable means in ecological research on bats (Heise 1982, Gerell and Lundberg 1985). The great interest in bat boxes has resulted in new models (e. g., Haensel and Näfe 1982). Very few tests, however, have been made to evaluate the attraction of the different types of boxes on bats.

In 1979 I tested three types of boxes, "Stratmann FS 1" (original model, Stratmann 1973), made of wood (Fig. 1 A), "Schwegler 2 F", made of concrete mixed with sawdust (Fig. 1 B), and a Polish sawdust-concrete nestingbox for birds (Fig. 1 C). The results showed that the "Schwegler" box was superior to the other two in attracting bats (Gerell 1980/81).

New tests

In order to test more boxes, also own models, I started new tests in 1981. The tests were carried out in a pine plantation of medium age, located 30 km to the east of Lund in southern Sweden. The boxes were put up close to each other (c. 10 m apart) at 25 different stations. One box each of the different models to be tested was represented at each station. The first test comprised the boxes tested earlier, exclusive the Polish nestingbox for birds (Fig. 1 C), together with a new model designed by Dr. B. Frylestam (Fig. 1 D). This box was made of porous concrete (Siporex). Porous concrete is easy to work but somewhat fragile. In order to diminish water absorbtion, the box was painted with a synthetic paint. The inner space of the box is cylindrical (ϕ 70–90 mm, height 250 mm). The entrance of the box is a slit at the bottom of the front.

The second test, started in 1982, included four new models. Type E (Fig. 1 E), a box of my own design, was made of rough boards (20 mm thick), measuring 70 × 250 × 400 mm inside. The opening of the box is a slit at the bottom of the front. Type F (Fig. 1 F), a Dutch design (anonymous designer), was made of wood. Like type A, the entrance of the box is at the bottom, being formed by the gap between the back and the front. Type G (Fig. 1 G) is the wellknown wooden box, designed by Dr. Issel. Type H (Fig. 1 H) was made of porous concrete, designed by myself. The inner space is a cylinder with a diameter of 90 mm and a height of 400 mm. The opening of the box is a slit in the lower part of the front.

The "Schwegler" box (type B) was excluded in the beginning of this test but reintroduced later in order to measure the "competitiveness" from the already established box models.

In 1983 and 1984, the test was changed in that boxes of type E and G were excluded.

The number of boxes available to the bats varied during the test periods due to nesting birds and wasps. Therefore, the frequency with which bats visited the boxes, a measure of the box' attraction on bats, was calculated only on boxes available to the bats.

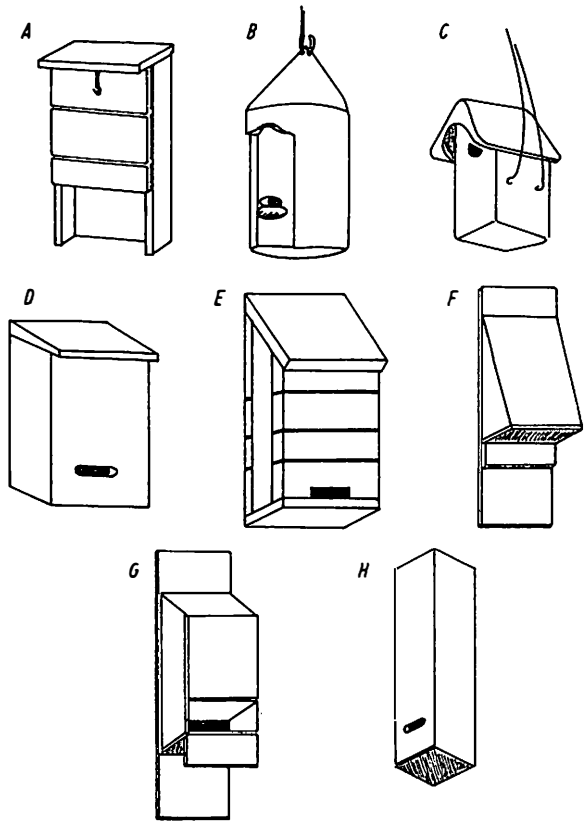

Fig. 1. Different types of bat boxes tested with regard to their attraction on bats. The sizes of the boxes are not comparable

Results

The visiting frequency of bats varied in the course of the season (Table 1), because the area was mainly used by the bats as a mating area (GERELL and LUNDBERG, op. cit.). However, *Myotis daubentoni* and *Pipistrellus nathusii* attempted to establish maternity groups.

Taking the visiting frequency figures as a measure of the attraction of the boxes, the first test shows that the box made of porous concrete (type D) was as good as the "Schwegler" box (type B) (Table 1). It was even better than the "Schwegler" box early and late in the season, i. e. in the colder periods.

The second test, started in 1982, shows that none of the new models introduced into the area (type E, F, G, and H) could compete with type D (Table 1). The re-introduction of the "Schwegler" boxes shows, however, that the high degree of site fidelity makes the bats favour already established boxes (GERELL and LUNDBERG, op. cit.).

Comparing boxes made of wood, the Dutch box (type F) was superior to the other models tested (Table 1).

The third test when box types E and G were excluded resulted in somewhat higher visiting frequencies at box types F and H.

Table 1. Visiting frequencies of bats (%) in different types of boxes

Date	No. of boxes	Visiting frequencies in per cent								No. of bats
		A	B	D	E	F	G	H	$\bar{x}$	
13. VI. 1981	113	7	47	36	0				18	26
29. VIII.	90	8	90	59	0				38	133
10. X.	91	12	27	64	4				26	61
10. VI. 1982	130	0		14	14	24	9	0	15	30
14. VII.	115	9		25	13	13	0	19	13	15
10. VIII.	139	4		67	13	9	9	13	18	53
22. VIII.	161	4	14	68	0	9	4	4	14	52
11. IX.	161	4	23	64	8	4	4	13	17	87
17. X.	160	4	18	64	5	0	0	13	14	55
4. VI. 1983	90	0	45	9		11		22	17	23
27. VI.	71	0	36	33		18		0	18	12
31. VII.	100	0	48	36		6		5	20	57
17. VIII.	100	6	38	64		11		14	28	72
29. VIII.	100	11	14	77		14		5	26	83
9. IX.	100	0	24	82		17		24	31	89
22. IV. 1984	106	4	9	67		15		9	22	100
21. V.	97	4	45	33		32		20	27	89

Table 2. Visiting frequencies (max) of bats, birds, and wasps in different types of boxes

Box type	Material	Visiting frequencies (max) in per cent		
		Bats	Birds	Wasps
A	wood	12	8	23
B	sawdust-concrete	90	9	50
C	sawdust-concrete	6	88	17
D	porous concrete	82	5	18
E	wood	14	17	17
F	wood	32	26	39
G	wood	9	9	4
H	porous concrete	24	48	0

Table 3. Choice of box type by different bat species

Species	Type of box							
	A	B	C	D	E	F	G	H
P. pipistrellus	×	×	×	×	×	×	×	×
P. nathusii	×					×		
M. daubentoni	×	×		×				×
M. brandti						×		
P. auritus		×			×		×	
E. nilssoni						×		
N. noctula	×	×		×				

The boxes were also used by birds and wasps for nesting (Table 2). Box of type C, a bird nesting box, attracted birds much more than it attracted bats. The high frequency of bird nesting in type H is explained by this box having a large opening that allowed birds to enter it. The "Schwegler" box (type B) attracted wasps more than any of the other kinds of box.

The choice of box type differed between different bat species (Table 3). *Pipistrellus pipistrellus*, the most common box visitor in the area, occurred in all types of boxes.

The height above the ground and the direction of the box were also analysed. The bats did not prefer any particular height within the range 2,0–5,5 m, but showed a tendency towards selecting boxes facing south. In spring, only sunlit boxes were chosen.

Discussion

From the results obtained it is obvious that boxes made of sawdust concrete or porous concrete are superior to those made of wood in attracting bats (c. f. HENZE 1968). The main reason seems to be that boxes made of concrete are dryer.

The tightness of the box is also of importance, especially during cold periods. This is confirmed by the movements of bats in autumn from the less tight "Schwegler" box to the tighter box of type D. The low attraction of the "Stratmann FS 1" can probably be explained by the same factor. Later improvements of this model have also been aimed at increasing insulation (HEISE 1980).

The inner volume of the boxes tested varied considerably, from c. 1600 cm^3 (type D) to 8100 cm^3 (type G). The results of the tests indicate that the bats preferred the smaller boxes.

None of the bat species present in the study area accepted boxes occupied by birds or wasps. The critical width of the entrance of the box that allowed very few birds to enter seemed to be 17 mm. As shown by some "Schwegler" boxes with a larger opening, the frequency of nesting birds will increase already with an opening of 18 mm. One solution of the problem is given by NAGEL (1982) who designed a box with a tubular entrance, keeping out the birds.

The design and the position of the entrance also seem to influence which bat species will visit the box. Two groups of bats with different preferences were discerned: those who selected boxes with a hole or a slit in the front of the box (type B, C, D, E, and H), and those who preferred boxes with a slot that opened at the bottom of the box (type A and F). The first group of bats comprised *Myotis daubentoni*, *Plecotus auritus*, *Nyctalus noctula*, and *Pipistrellus pipistrellus* (89% of the cases, n = 130). These bat species (except *P. pipistrellus*) primarily roost in tree holes. The second group, including *Pipistrellus nathusii* and *Eptesicus nilssoni*, seems to prefer roosts where they can crawl up behind a sheltering device, e. g., a loosened piece of bark or a roofing tile. As one can assume, competition for roosting places has resulted in different species having evolved different preferences (VERSCHUREN 1957). This is especially evident in closely related species, e. g., *Plecotus auritus/P. austriacus* (HANÁK 1969), *Pipistrellus pipistrellus/P. nathusii*, and probably also *Myotis mystacinus/M. brandti* (own observations).

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Zusammenfassung

Verschiedene Kastenmodelle für Fledermäuse (Abb. 1) wurden in Hinsicht auf ihre Besetzung untersucht. Die Untersuchung ergab, daß Kästen aus Holzbeton oder Leichtbeton dem Holz vorgezogen wurden. Die Kästen aus Holz, ein holländischer Typ (F), wiesen die höchste Besetzungsfrequenz auf. Zwei Gruppen von Fledermäusen konnten hinsichtlich ihrer Ansprüche auf Anbringung und Gestaltung des Einflugloches unterschieden werden. Folgende Arten zogen ein Loch oder einen Schlitz auf der Vorderwand des Kastens vor: *Myotis daubentoni, Plecotus auritus, Nyctalus noctula* und *Pipistrellus pipistrellus.* Diese Arten sind typische Baumhöhlenarten. Die andere Gruppe, bestehend aus *Pipistrellus nathusii* und *Eptesicus nilssoni,* zog einen Schlitz an der Unterseite des Kastens vor, wo sie hineinkriechen konnten.

References

GAISLER, J. (1979): Ecology of bats. In: STODDART, D. M. (ed.): Ecology of small mammals. London, 281–342.

GERELL, R. (1980/81): Bat conservation in Sweden. Myotis **18–19**, 11–15.

–, and LUNDBERG, K. (1985): Social organization in the bat *Pipistrellus pipistrellus.* Behav. Ecol. Sociobiol. **16**, 177–184.

HAENSEL, J., u. NÄFE, M. (1982): Anleitungen zum Bau von Fledermauskästen und bisherige Erfahrungen mit ihrem Einsatz. Nyctalus (N. F.) **1**, 327–348.

HANÁK, V. (1969): Ökologische Bemerkungen zur Verbreitung der Langohren (Gattung *Plecotus* Geoffroy, 1818) in der Tschechoslowakei. Lynx **10**, 35–39.

HEISE, G. (1980): Ein Verfahren, um die Effektivität des Fledermauskasteneinsatzes zu erhöhen. Nyctalus (N. F.) **1**, 187–189.

– (1982): Zu Vorkommen, Biologie und Ökologie der Rauhhautfledermaus (*Pipistrellus nathusii*) in der Umgebung von Prenzlau (Uckermark), Bezirk Neubrandenburg. Ibid. **1**, 281–300.

HENZE, O. (1968): Fledermäuse bevorzugen Holzbetonkästen. Myotis **6**, 5–8.

NAGEL, A. (1982): Ein neuer Kasten für Fledermäuse. Ibid. **20**, 45–47.

STRATMANN, B. (1973): Hege waldbewohnender Fledermäuse mittels spezieller Fledermausschlaf- und -fortpflanzungskästen im StFB Waren (Müritz). Teil 1. Nyctalus **5**, 6–16.

VERSCHUREN, J. (1957): Ecologie, biologie et systématique des chiroptères. Exploration du parc national de la Garamba. Bruxellus: IPNCB (cited by GAISLER 1979).

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