Why does the Wryneck *Jynx torquilla* bring strange items to the nest?

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Analyses were made of the contents of 121 Wryneck nests, collected after the breeding season in different parts of Finland in 1976—79. The numbers of strange items (stones, pieces of glass, porcelain, metal, putty, paint, plastic, egg-shell and bone fragments, and whole or broken bivalve and gastropod shells, etc.) indicate that the tendency to bring such objects to the nest should be regarded as the rule rather than the exception among Finnish Wrynecks. The mean number of items in a nest was 37.4, and only 9 (7.4 %) nests lacked such objects. Some Wryneck pairs had brought more than 200 objects to the nest.

The annual mean numbers of strange objects were fairly constant and no significant differences could be detected between different parts of the country. Some variation in the nature of the objects was detected between the years. The nesting locality affected the nature but not the quantity of the items. Of the 64 dead nestlings dissected, 7 (11 %) had died from eating strange objects. The numbers of items in the nests showed no significant correlation with the numbers of fledglings, which indicates that they had no great effect on the nesting success.

Experiments with test objects revealed that the tendency to bring strange items to the nest is most pronounced at the end of the nestling period, when the parents are busiest feeding the young. The stimuli from strange items together with the inner motivation, or drive, of the parent bird to search for food for its young release the picking up reaction. Some of the test objects also elicited picking up activity in parents inside the nest, but in this situation the objects were thrown or carried out of the nest.

The tendency to bring strange items to the nest should not be regarded as adaptative behaviour supplementing the diet of the nestlings, but as the consequence of an error or mistake in the release of the picking up pattern in the parent bird. Learning seems to be involved in the adoption of strange objects and, in some cases, this seemed to have facilitated the utilization of novel food items.

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Introduction

The Wryneck is a myrmecophagous bird, which also feeds the nestlings with ants and ant cocoons. Occasionally, other types of food are utilized and 'strange' items may be brought to the nest. Most of the latter objects are not consumed by the nestlings and remain at the bottom of the nest after the breeding season (Dekhuyzen-Maasland et al. 1962, Klaver 1964, Dornbusch 1968, Heuer & Krägenow 1973). Many of the strange items have no nutritional value and, in some cases at least, they have caused the death of one or more nestlings (Christensen 1975). In Finland the nestling mortality due to such objects seems to be low (Terhivuo 1977).

Klaver (1964) and Löhrl (1978) suggested that some of the items are important for the nestlings. For instance, small stones may facilitate digestion by grinding the chitinous parts of the ants consumed by the nestlings, and the egg shell fragments possibly compensate for a deficiency of Ca and P in the diet. Thus, they consider the tendency a behavioural adaptation of the parents. Terhivuo (1977) suggested that the stimuli from the strange objects are usually inferior to those from food items, and that a temporary scarcity of food may induce the parent bird to pick up strange objects and bring them to the nest.

The present paper reports on the contents of 121 Wryneck nests analysed in 1976—79 in Finland. Attention has been paid to the annual and regional variation in the quantity and nature of the objects and to the nesting success of the Wryneck pairs. The frequency with which objects are brought to the nest in different phases of the nesting period was studied by laying out groups of test objects in the vicinity of the nests.

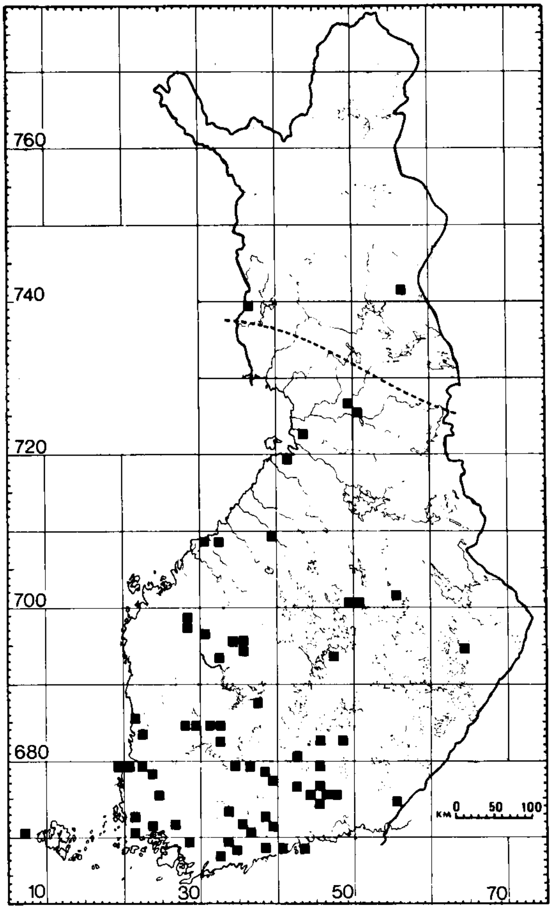

Fig. 1. The localities sampled in 1976—79. The broken line indicates the northern limit of the regular breeding range of the Wryneck in Finland (v. Haartman et al. 1963—72).

Material and methods

Nest contents. The 121 nests of the Wryneck were collected by Finnish ornithologists in different parts of the country after four breeding seasons (1976 21, 1977 48, 1978 27 and 1979 25 nests). The samples were taken irrespective of the nesting success, most of them from nest-boxes emptied annually. Data on the habitats of the nests and the nesting success of most pairs were also received. The locations sampled are indicated in Fig. 1. For the grid system adopted, see Heikinheimo & Raatikainen (1971).

Experiments with test objects. Groups of test objects were placed on the ground in the vicinity of the nest. The objects were set out in the evening when the birds had ceased searching for food and were counted the next evening at the same time. Objects that were removed were replaced with new objects marked with the same symbols. The procedure was repeated once or several times. When the breeding season was over the numbers of objects in the nests were counted. These experiments involved 8 Wryneck pairs and were carried out in 1978—79.

The test objects were 9x9 mm pieces of cream white embossing tape (Dymo, clear 5238), each marked with a letter and a number. The thin film at the back of the tape was not removed.

Prior to the experiments the contributors were asked to check the onset of egg-laying of the Wrynecks. When the clutch was completed, test objects marked with the sign A were set out in the vicinity of the nests in places where the birds were observed to search for food. Objects marked A1 were laid under the nesting tree, and objects with higher serial numbers at increasing distances from the tree, as follows: A2 20—30 m, A3 50—60 m, A4 100—150 m and A5 200—300 m. Sets of 10 objects, in some cases fever, were laid out in each site.

When the nestlings hatched, the objects with sign A were replaced with objects marked B, and when the nestlings were 10—12 days old these were exchanged for series C, which was used up to the end of the nesting period. The same sites were used for the groups of objects throughout the experiment.

In addition, in 1979 (3 pairs) and 1981 (2) the colour preferences of the Wryneck parents were studied with tape of different colours: cream white, red, yellow, blue, green and black. These experiments resembled those described above, with the exception that 6 different objects were now included in each group.

Results

Annual and regional variation in the numbers of strange objects. The number of objects recorded in the 121 Wryneck nests totalled 4528. Only 9 nests (7.4 %) lacked other objects than the droppings of the nestlings. Fig. 2 shows the numbers of objects found in the nests. This negative binomial frequency distribution shows that in about half of the nests the numbers of objects were rather low (0—20). The mean number of objects in a nest was 37.4 (Table 1). Table 1 shows the annual variation in the mean numbers of items. The Kruskal-Wallis test revealed no significant differences between the years ($H^*=1.59$, df=3).

The regional variation in the numbers of objects was studied by calculating the mean numbers for the pairs in three regional zones, viz. 660—680, 680—700 and 700—750 (see the grid in Fig. 1). The means (±SE) were 36.2±5.4 (N=57), 35.0±8.0 (N=42) and 46.7±13.5 (N=22), respectively. The Kruskal-Wallis test indicated no statistically significant differences between the zones ($H^*=1.24$, df=2). Nor was there any significant difference between pairs nesting in habitats with constant human influence (mean 38.4±6.3, N=66) and pairs nesting in sites with very weak or no human influence (mean 30.9±6.4, N=35) ($H^*=0.05$, df=1). Thus, the geographical location and nesting habitat do not seem to affect the frequency of strange objects in the nest. Moreover, the number of the objects varied greatly even when nesting took place in successive years in the same nest-box.

The nature of the strange objects. Table 2 shows the percentages of the different kinds of objects recorded in the nests. The first five categories comprise items without any potential nutritive value. These total 54.1 % of all the items. The other four categories involve objects which might have contributed to the diet if consumed by the nestlings.

Since the objects indicated in Table 2 were found at the bottom of the nests, the parents had not fed them to the nestlings, or they had been rejected by the nestlings. The objects include small stones, pieces of cement, putty, porcelain, glass, plastic, paint, wax, metal, fragments of egg-shells (those belonging to the Wryneck were excluded), pieces of exotic bivalves used in feeding hens, the whole or parts of gastropod and bivalve shells of Finnish species, bones and scales or fragments of them (most probably picked up from trash heaps close to human settlements) and heavily chitinized invertebrates or parts of them (e.g. diplopods, coleopterans, isopods, insect cocoons). Plant material was scarce. The location of the nest affects the nature of the objects, since different kinds of waste material (glass, porcelain, putty, etc.) were more abundant in the nests close to human settlements than in those far from them. Near Rauma, on the other hand the Wrynecks had brought 81 fish scales and bones to the nest (pair of the Osprey *Pandion haliaetus* nesting in the vicinity) and in Eckerö, Signilskär, 79 isopods were caught. Both locations were far from human settlements.

The annual variation in the nature of the objects was examined by dividing the material into two groups: (1) objects composed of inorganic material without any potential nutritive value (the first 5 categories in Table 2), and (2) objects which might have contributed to the diet of the nestlings (the last 4 categories). The percentages for the first group in the four years (1976—1979) are: 49.9, 63.9, 32.6 and 58.9. The differences between the four years are highly significant (χ^2=250.9***, df=3). Accordingly, although the mean numbers of the objects in the nests did not vary much annually (Table 1), the nature of the objects did. This is discussed in more detail later.

I also inspected many of the droppings left in the nests and they mostly consisted of chitinous parts of ants. Very small stones measuring <2 mm were fairly often present, and sometimes tiny shell fragments and spruce needles were found, too. It is worth noting that the shell fragments were not much affected by the digestion process (see also Heuer & Krägenow 1973).

Number and nature of objects in relation to nesting success. The data on the nesting success of the pairs include records of nests in which all the young died and nests in which some fledged. The broods of the former group total 12, or 9.9 % of all the broods. I dissected 25 nestlings from

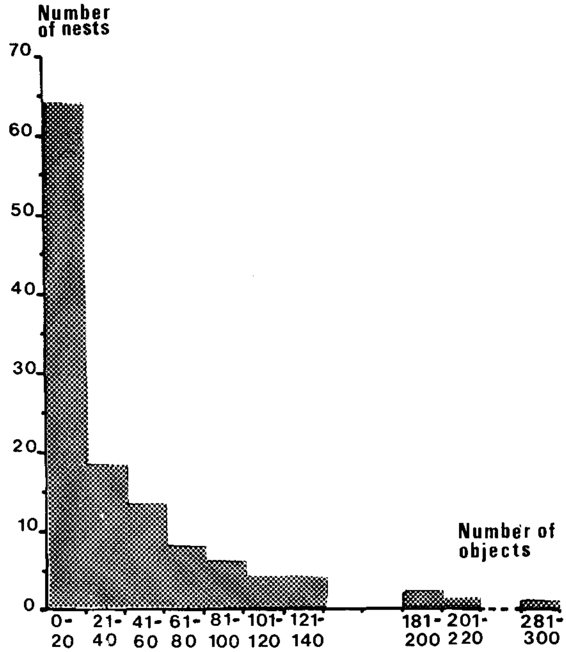

Fig. 2. Numbers of objects in 121 Wryneck nests collected in 1976—79 after the breeding season.

six broods in this group. In 14 the stomachs were empty; in the other 11 they contained chitinous parts of ants, Hymenoptera cocoons, some plant material, tiny stones and some spruce needles. In one of them the stomach was almost full of plant lice (Homoptera). None of these nestlings had been killed by eating a strange object. I also dissected 39 dead nestlings from 24 nests with at least one young fledged. In 7 of them (18 %) death was caused by object(s) stuck in some part(s) of the alimentary canal. These items were (1) a piece of glass and a piece of porcelain in the stomach, (2) an air-gun bullet and two pieces of blue plastic in the stomach, (3) a very big frag-

Table 1. Annual variation in the mean numbers of objects recorded in the 121 Wryneck nests studied in 1976—79. The Kruskal-Wallis test applied to the actual numbers of objects indicates no statistically significant differences between the four years. (H^*=1.59, n.s.). The nesting success of the pairs is not considered.

Year	No. of nests	No. of objects	
	N	Mean±SE	Range
1976	21	42.5±10.9	3—212
1977	48	40.1± 8.3	0—297
1978	27	32.6± 8.0	0—188
1979	25	33.2± 7.8	0—136
Total	121	37.4± 4.5	0—297

Table 2. Classification of the objects in the Wryneck nests in 1976—79. The first five categories comprise objects without any possible nutritional value to the nestlings, the other four those which might have contributed to the diet, if consumed by the nestlings.

Objects	1976 (%)	1977 (%)	1978 (%)	1979 (%)	Total (%)
Stones (Ø 2—10 mm)	23.6	22.8	6.4	25.7	20.3
Cement, putty	10.5	3.1	1.1	0.4	3.7
Glass, porcelain	11.8	31.3	9.9	15.7	20.4
Plastic, paint, wax	3.2	5.0	14.2	17.0	8.6
Metal	0.8	1.7	1.0	0.1	1.1
Fragments of eggs, gastropod and bivalve shells	39.9	27.4	38.8	25.6	31.7
Bones, scales, fragments of vertebrate bones	8.5	2.0	24.6	11.4	9.4
Chitinous invertebrates or their parts	1.7	6.5	3.9	4.2	4.6
Seeds, berries	—	0.2	0.1	—	0.1
Total number of objects	893	1927	879	829	4528
Total number of nests	21	48	27	25	121

ment of bivalve shell in the stomach, (4) 4 pieces of plastic (the test objects) and 1 white stone in the stomach, (5) two big pieces of bone in the stomach, (6) one very big fragment of the shell of *Bradybaena fruticum* (gastropod) stuck in the throat and (7) six stones and one piece of egg-shell in the stomach. In the other nestlings studied the stomachs were either empty or contained some plant material, chitinous parts of ants and/or tiny stones. Of all the nestlings dissected, about 11 % seem to have died from eating strange objects.

No statistically significant correlation was found between the numbers of the objects and the fledglings within the years or in the total material. Nor was there any significant difference between the mean number of fledglings in nests with ≥ 100 items (N=10, mean 6.6±0.62, range 3—9) and in nests with only ≤ 20 items (N=31, mean 6.4±0.39, range 2—10).

The following procedure was used to study both the number and nature of the objects in relation to the nesting success of the Wrynecks. All the nests with at least one fledgling were divided medianly into two categories: those with 25 or fewer items and those with more than 25. Both categories were further divided medianly into two groups (A, B and C, D, respectively) according to the percentages of the objects with possible nutritive values for the nestlings. In A and B, the mean percentages of such items were 25.1±7.0 % (SE; N=17) and 93.1±2.5 % (N=17), respectively, and in C and D 11.0±1.9 % (N=18) and 79.5±4.1 % (N=17). Factor analysis of variance applied to the numbers of fledglings in groups A—D indicated no statistically significant differences between the four groups ($F=0.886$, $df_1=3$, $df_2=65$).

Experiments with test objects. The data given in the previous sections leave many questions unanswered. Do the Wrynecks pick up strange objects with equal frequency in all phases of the nestling period? How far from the nest were the objects found? Do local weather conditions enhance the tendency, and do the parent birds show any colour preference? It was in order to obtain some answers to these questions that the test objects were set out for the parent birds during different phases of the nesting period.

Table 3 shows that the frequency with which the objects were brought to the nests varies greatly between the different phases of the nesting period. Only 5 objects were removed from the groups during the incubation period and there is no clear evidence that they were taken by the Wrynecks. The percentage of the total number of objects available found in the nests (c/a) differs highly significantly between the first and the second half of the nestling period ($\chi^2=136.6^{***}$, df=1). Since the parents feed their young more often during the second half (e.g. Bussmann 1941, Ruge 1971), the tendency to pick up such objects seems to be related to the feeding frequency.

Only about 55 % of the objects removed were found later. Since the percentages of the objects removed (b/a, Table 3) were also highest at the end of the nesting period, it is very likely that they were carried somewhere by the Wrynecks. This is also suggested by the fact that some of them were found under the nest-box, having evidently been thrown out of the nest. The tendency to take the test objects differed among the pairs studied and other types of strange objects were present in the nests, too. Some of the birds possibly used to visit sites where the test objects were

Table 3. Data from the field experiments with cream white test objects of plastics laid out in groups of about 10 in the vicinity of the Wryneck nests during different phases of the breeding period. The sites of the groups were always the same. Each object was available for one 24-h period. Symbols: 1 = the group laid out 0—2 m from the nest, 2 = 20—30 m, 3 = 50—60 m, 4 = 100—150 m and 5 = 200—300 m from it. See also the text.

	Incubation period						Nestlings 1—10 days old						Nestlings more than 10 days old						No. of other items
	1	2	3	4	5	Σ	1	2	3	4	5	Σ	1	2	3	4	5	Σ	
No. of objects available (a)	220	220	220	216	220	1096	320	320	320	313	320	1593	327	343	337	340	340	1687	—
No. of objects removed (b)	—	3	1	1	—	5	42	44	20	56	12	174	147	107	74	91	3	422	—
No. of objects found in the nests (c)	—	—	—	—	—	—	17	17	3	15	—	52	95	70	52	63	—	280	444
b/a (%)	—	1.4	0.5	0.5	—	0.5	13.1	13.8	6.3	17.9	3.8	10.9	45.0	31.2	22.0	26.8	0.9	25.0	—
c/a (%)	—	—	—	—	—	—	5.3	5.3	0.9	4.8	—	3.3	29.1	20.4	15.4	18.5	—	16.6	—
No. of Wryneck pairs				8					7						7				

not available, but, since the objects under the nesting tree were not taken by all the pairs, the pairs evidently "accepted" the test objects unequally, too. The process of learning to "utilize" the groups of test objects may have been important in this respect.

The majority of the objects found originated from groups lying less than 200 m from the nests. In general, the farther the group was, the fewer were the objects from it found inside the nest.

The data obtained on the colour preferences of the Wrynecks were meagre; only two of the test objects were found inside the nests and both were white. Of the 22 test objects removed from the groups, the majority were white (27.3 %) and black (22.7 %).

Discussion

Bringing strange objects to the nest should undoubtedly be regarded more as the rule than the exception among nesting Wrynecks in Finland. What can be the reason for this tendency? The suggestion that it is adaptive behaviour, which supplements the diet of the nestlings with Ca and P and improves the efficiency of digestion (Klaver 1964, Löhrl 1978) is open to criticism. True, very small stones were found in the stomachs of the nestlings, but these stones seem to have been picked up with the ants, as were, no doubt, also the spruce needles found together with them in the stomachs. Small fragments of egg-shells, gastropods and other lime-rich items may improve the nestlings' diet to some extent, but it is questionable whether this is the ultimate reason for the tendency.

Sutter (1941) showed that 10—12-days old nestlings have already gained about 2/3 of the total weight of the adult, and that at about the same time the growth rate of many of their bones considerably decreases. Since objects are picked up most frequently at the end of the nesting period (Table 3), it is not easy to understand how this tendency can have any great improvement to the Ca and P contents of nestlings' diet. In general, there seems to be no reason to assume that the diet of the nestlings is inadequate or that the ants are not efficiently digested.

As regards the experiments with test objects, some facts should be stressed. Like the other strange objects, these do not seem to be seen by the parent birds solely as food items, since some of the objects brought to the nest were later picked up and thrown out. As the parents carry or throw many of the droppings of the nestlings outside the nest (e.g. Klaver 1964), it is very likely that once inside the nest, the test objects were regarded as droppings. Accordingly, the objects can be differently treated, depending upon the inner motivation of the parent bird. The behaviour released by the test objects is picking up activity, but the subsequent behavioural pattern, i.e. what the Wryneck does with the objects, seems to depend on the inner motivation of the bird. Thus, the tendency to bring strange items to the nest should be regarded as the consequence of a kind of error or mistake in the release of the picking up pattern of the Wryneck parent. At the end of the nestling period the motivation of the parent to search for food for the nestlings is at its highest, as is indicated by the numbers of feeding visits made by the parents (e.g. Ruge 1971). Consequently, during this time strange objects may more easily elicit the picking up pattern in parent birds.

Terhivuo (1977) reported that the feature common to the strange objects in the nests and the normal food items, i.e. ants and ant cocoons, is their more or less shiny surface. In addition, the majority of the strange objects are whitish or transparent in colour. This is also supported by the few data received from the experiments with coloured test objects. When food is abundant, the stimuli from it seem to be superior to those from other objects, e.g. the pieces of tape. In general, if the stimuli from the strange objects were superior or even equal to those from the ants and ant cocoons, the nesting success and even the existence of the species would be endangered. In this connection, a letter from Mr. A. Suoranta deserves mention. He described how a Wryneck in search of food for its young in Tammela picked up ants very close to an ant heap lying within 30 cm of a group of test objects. No test objects were accepted by the parents, even later in the season, though 65 other "strange" items were found inside their nest after the breeding period. On the other hand, scarcity of food, although merely momentary, together with the stimuli from strange objects may elicit picking up behaviour in a Wryneck parent with a high motivation to find food for the nestlings.

In some cases at least, the adoption of "unusual" items may result in utilization of novel food sources. This is indicated by the great number of fragments of terrestrial gastropods undoubtedly broken up by parent birds, and by the large amount of plant lice found in one of the dead nestlings. Probably learning also plays a role in this adoption. The tendency may thus have some adaptive value for the species, especially when food is scarce.

Table 3 shows that Wryneck parents searched for food for the nestlings fairly close to the nest, and the nature of the strange objects found inside the nest indicates that the Wrynecks had visited rather "unusual" places such as heaps of trash, dirtroads, shores etc. What made the Wrynecks visit them? One may hypothesize that although food may be scarce in such places parent birds can learn to visit them if there are items able to release the picking up pattern, so that the bird has something to bring to the nest. The physiognomical features of these sites may also deserve consideration. For instance, heaps of trash and manure are usually conical in shape and well demarcated from the surroundings, to the Wrynecks they may well resemble a huge ant-heap.

There was great annual variation in the nature of the objects found inside the nests. Since the nesting habitat had an impact upon the nature of the objects, it may be that different types of habitats are not evenly represented in the samples of the nests taken in 1976—79. Moreover, in 1978—79 the temperature conditions during the nestling period (latter half of June — first half of July) were more favourable than in 1976—77 (Ilmatieteen laitos 1976, 1977, 1978, 1979). Since there was no significant annual variation in the mean numbers of objects in the nests, we cannot conclude that they were afffected by the overall weather conditions. However, the effect of the local weather conditions during the nesting period on the tendency to pick up strange objects should be studied in more detail.

The Wryneck picks up ants and ant cocoons with its long, mucous tongue but does it take other than food items that way, or does it pick up the latter with its bill, is not known. Some of the gastropod shells were broken up by the Wryneck with its bill. Moreover, does the Wryneck prefer ants and ant cocoons to strange items because of their appearance and/or flavour?

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Selostus: **Miksi käenpiika tuo pesäänsä vieraita esineitä?**

Kirjoittaja tutki eri puolilta Suomea vuosina 1976—79 tallennetut 121 käenpiian pesää (kuva 1). Näytteissä oli mm. pieniä kiviä, lasin-, posliinin-, ikkunakitin-, sementin-, metallin-, muovin-, maalin- ja vahanpalasia, kotiloiden, simpukoiden ja kananmunan kuoria sekä luiden kappaleita, kalan luita ja suomuja ja kitiinipintaisia selkärangattomia (mm. kaksoisjalkaisia ja siiroja). Pesissä oli keskimäärin 37.4±4.5 (SE) esinettä. Vain 9 (7.4 %) pesässä niitä ei ollut. Tapa tuoda vieraita esineitä pesään ei siis ole poikkeus vaan sääntö Suomessa pesivillä käenpiioilla.

Vieraiden esineiden lukumäärät eivät vuosittain vaihdelleet tilastollisesti merkitsevästi (taulukko 1), mutta laatu kylläkin (taulukko 2). Pesimäympäristöllä ei ollut vaikutusta esineiden määrään. Lentopoikasten ja vieraiden esineiden lukumäärien välillä ei ole merkitsevää korrelaatiota. Kirjoittaja tutki 25 kuollutta poikasta 6 pesyeestä, joista ei tullut lentopoikasia, mutta yhdenkään poikasen kuolemaa eivät vieraat esineet olleet aiheuttaneet. Lisäksi tutkittiin 39 poikasta 24 sellaisesta poikueesta, joista tuli vähintään yksi lentopoikanen. Näistä 7 poikasta oli kuollut koska niiden ruoansulatuskanavaan oli tarttunut teräväreunaisia, sulamattomia esineitä.

Atrappikokeissa asetettiin eri etäisyyksille pesistä muovinpalasia, joiden häviämistä seurattiin vuorokauden mittaisissa jaksoissa pesimäkauden eri vaiheissa (taulukko 3). Taulukossa 3 a-rivit osoittavat tarjottujen, b-rivit poisvietyjen ja c-rivit pesästä löytyneiden atrappien lukumäärät. Atrappien määrät eri pesissä vaihtelivat suuresti, ja emot toivat pesiin myös muita esineitä. Tuonti oli vilkkainta pesäpoikasajan lopussa.

Kirjallisuudessa esitetään, että tapa kantaa esineitä pesään on emolintujen ravinnonhakukäyttäytymiseen liittyvä sopeutuma (adaptaatio), jotta poikaset saisivat enemmän kalsiumia ja fosforia, jota muurahaisravinnossa on vähän. Pienet kivet puolestaan saattaisivat tehostaa mm. muurahaisten hienontumista ruoansulatuskanavassa. Tutkimus osoitti, että pesäpoikasten ja kalkkipitoisten esineiden määrien välillä ei ole korrelaatiota. Koska lisäksi pesäpoikasten luiden kasvu hidastuu ja painokin on jo 2/3 aikuisen painosta kun poikanen on vasta 10—13 vrk:n ikäinen, on vaikeaa ymmärtää, että tapa olisi poikasten kasvua edistävä adaptaatio, sillä esineitähän tuodaan pesään runsaimmin vasta pesäpoikasajan lopussa.

Ärsykkeet vieraista esineistä ovat heikompia (suboptimaalisia) kuin normaalista ravinnosta tulevat, muutoin lajin jälkeläistuotto kärsisi tuntuvasti. Ennenkuin esine viedään pesään, tarvitaan ärsyke, joka saa emon poimimaan esineen nokkaansa. Sisäisen viretilansa mukaisesti emo, ollessaan etsimässä poikasille ravintoa, vie esineen edelleen pesään. Mutta emo voi poimia esineitä myös pesästä, esim. poikasen valkean, kiiltäväpintaisen ulostepallon. Viretilan ollessa nyt toinen, se vie tai heittää ulosteen pois pesästä — näin eräät emot menettelivät myös atrappien kanssa. Viretilasta riippuen emot siis menettelevät esineiden kanssa eri tavoin, mutta yhteisenä piirteenä on, että näitä toimintoja edeltää ärsyke, joka saa emon poimimaan esineen nokkaansa. On ymmärrettävää, että pesäpoikasajan lopulla emojen viretila (poikasten ruokkiminen) on voimakkaimmillaan ja siksi juuri silloin tuodaan vieraita esineitä pesään runsaimmin. Ehkä ravinnon hetkellinen niukkuus "epätavallisilla paikoilla" (tunkiot, kanatarhat ym.), joissa emot ovat vierailleet, on ollut suboptimaalisten ärsykkeiden vaikutusta lisäävä tekijä.

Tapa tuoda esineitä pesään on siis seuraus eikä syy emojen ravinnonhakukäyttäytymistä ajatellen. Koska käenpiiat olivat käyttäneet poikastensa ravinnoksi mm. kotilojen pehmeitä kudoksia ja kun erään poikasen mahasta löytyi runsaasti kirvoja, on selvää, että emot ovat ajoittain hyödyntäneet uusia ravintokohteita. Virhetoiminnan laukeaminen saattaa johtaa, ehkä oppimisen kautta, uusien ravintokohteiden hyödyntämiseen. Tällöin ilmiöllä saattaisi olla lajille adaptiivistakin merkitystä.

Aineisto ei paljon kerro oppimisen merkityksestä emojen ravinnonhakukäyttäytymisessä. Eräät parit kuitenkin toivat atrappeja pesään runsaasti, toiset taasen eivät niihin reagoineet, mutta toivat muita esineitä pesään sitäkin enemmän. Ehkä emot oppivat jo ennen pesinnän alkua hakemaan ravintoa paikoista, joissa käyvät myös pesäpoikasten aikana.

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