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CAPTIVITY AFFECTS SPERM PRODUCTION, TESTES SIZE AND BEAK COLOR IN HOUSE SPARROWS (*PASSER DOMESTICUS*)

ABSTRACT

We held 17 male House Sparrows in an outdoor aviary from May-July 2005 to repeatedly collect semen samples from them to be used later in the development of artificial insemination techniques. Birds were housed individually, but in visual and auditory contact with other House Sparrows of both sexes. Beginning on 15 June, and every third day thereafter, we used cloacal massage to collect semen samples. By 12 July, only 2/17 (11.8%) of captive males still produced sperm and the beaks of most males had begun changing from black to horn-colored; both are signs of decreased testosterone production. To rule out the possibility that these changes were due to seasonal effects, we captured 9 wild adult male sparrows on 13 July. In contrast to the captive males, most wild sparrows (7/9; 77.8%) produced sperm on 14 July and all of them had completely black beaks. Captive males had significantly less black on their beaks and smaller combined testes mass than did wild males. We found sperm in the testes and seminal glomera of wild but not captive sparrows. These results are consistent with the conclusion that the captive males suffered a decline in testosterone levels with subsequent physiological effects. We hypothesize that the stress of captivity and handling resulted in chronic elevation of corticosterone which caused a decline of testosterone producing testicular atrophy, a decrease in sperm production, and a change in beak color.

Key words – captive studies, House Sparrow, *Passer domesticus*, spermatogenesis, testes, testosterone.

INTRODUCTION

House Sparrows (*Passer domesticus*) are common subjects of both field and laboratory studies of birds because of they are nonmigratory, have a wide geographic range, and live in close association with humans (Lowther and Cink 1992). However, it is unclear why it is difficult to breed these otherwise adaptable birds in captivity (Anderson 2006). The opportunity for social interactions appears to be an important requirement; breeding success is greater in groups of House Sparrows caged together than in isolated pairs (Anderson 2006). Moreover, Hegner and Wingfield (1984) suggested that social facili-

tation may be essential for male gonadal development because they observed greater testicular recrudescence in males housed in flocks than in males housed in pairs. Here we report the results of a study during which we serendipitously found that captivity had a negative effect on sperm production, testes size and beak color in male House Sparrows. This finding may help explain why it is difficult to breed House Sparrows in captivity (Anderson 2006).

We held male House Sparrows in captivity so we could collect multiple semen samples from individual males in an effort to develop artificial insemination techniques (Gee and Sexton 1983, Gee and Temple 1978, Gee et al. 2004) that could eventually be used to study the dynamics of multiple mating in wild birds. We found that sperm production declined in captive males. This was surprising for several reasons. First House Sparrows have been bred, albeit with difficulty, in captivity (Mitchell and Hayes 1973, Baker 1995, Moreno-Rueda and Soler 2002). Second, the failure of non-domesticated wild birds to breed in captivity (Lambrechts et al. 1999, and references therein) is rarely, if ever, attributed to the failure of captive male birds to maintain spermatogenesis (Snyder et al. 1996). Last, in their comprehensive review of artificial insemination techniques in non-domesticated birds Gee et al. (2004) did not report captivity negatively affecting sperm production as a problem typically encountered by aviculturists.

STUDY AREA

We studied House Sparrows that we captured on and within 16 km southeast of the Grand Valley State University (GVSU) campus in Allendale, MI, USA (42.5° 57' N, 85° 53' W).

MATERIALS AND METHODS

We used mist nets and walk-in traps to capture 17 male and eight female sparrows during May-June 2005. When each bird was captured, we measured its mass with a spring scale to the nearest 0.2 g, right tarsus length with an electronic digital caliper to 0.01 mm, and right wing chord length to the nearest 1 mm with a ruler with a stop fixed to one end. We photographed each male's bib (chest area) using a scale bar and a Nikon Coolpix® 5 megapixel digital camera and used SCION image analysis software (www.scioncorp.com) to determine bib area. Each sparrow was assigned an identifying number and given a unique combination of colored plastic bands for individual identification.

Once preliminary measurements were completed, each bird was put into a standard finch breeding cage (33 cm x 27 cm x 33 cm; length x width x height, respectively, with 1.27 cm bar spacing). Each cage contained one hardwood perch, two plastic cups for food and water, and one nest box. Each cage was separated from an adjacent cage by a partition with 1.27 cm bar spacing. Cages stacked on racks so that each rack contained

four sets of two adjacent cages. Consequently, all sparrows were in auditory and visual contact with sparrows of both sexes. Sparrows were housed individually to reduce intraspecific aggression and to reduce the chances of the cloacal microbe transmission between males. This second reason was important because we had also set out to compare the semen microbe loads of individual males. All cages were in a covered screen tent outdoor aviary (9.29 m^2 floor area, 2.44 m center height). The screen tent shaded the sparrows but allowed them to be exposed to natural photoperiods and protected them from rain and biting insects. Nesting materials, food, and water were provided ad libitum. We fed the sparrows a commercial seed mix (KAYTEE Supreme Canary Fortified Daily Blend; crude protein 15%, crude fat 10%, crude fiber 10%, moisture 12%) periodically supplemented with other nutrients and vitamins (Scott's Petamine Breeding Formula) and grit. Cages were cleaned every third day.

Sparrows were held in captivity from 17 May – 14 July. Of the 17 males and eight females, 16 males were individually housed, one male was housed with a female from 31 May – 14 July to determine if pairs housed together would breed in captivity, and the remaining seven females were individually housed. We allowed males to acclimate to the conditions of captivity for at least 4 days before we began to attempt to collect semen samples from them. We restricted the time we spent at the aviary to visits to feed and water birds, clean cages, and obtain semen samples to reduce the amount of investigator-induced stress on the sparrows. In addition, the aviary was located in a partially hidden location on campus not often frequented by people so as to reduce disturbance.

We collected semen samples from captive sparrows every third day from 15 June – 12 July. Samples were collected in 0.5 µL aliquots using cloacal massage (Samour et al. 1986). Lombardo performed all cloacal massages. Because we were attempting to collect sufficient volumes of semen from each male for use in artificial insemination experiments we collected samples until we were unable to obtain any semen during each sampling attempt. Trace samples (samples < 0.5 µL) were collected and recorded as 0.1 µL. Samples were collected using micropipets with sterile tips and diluted 1:1 in Beltsville poultry semen extender (Bakst and Cecil 1977). Sub-samples from this dilution were prepared for cryopreservation and artificial insemination.

Semen samples were examined for the presence of sperm cells the same day they were collected. If sperm cells were present, sub-samples were used to calculate sperm concentrations. Three sub-samples from each sample were counted using an improved Neubauer hemacytometer (Reichert, Buffalo, New York) at 1000X magnification on a compound microscope. We used the mean sperm concentration (sperm μL^{-1}) of the sub-sample counts to calculate the total number of sperm cells obtained in each sample. Our assistant E. McCombs examined samples for sperm and counted sperm in all semen samples.

As sampling progressed, it became increasingly difficult to obtain semen samples. To determine if captivity affected sperm production we compared sperm production of our captive sparrows, hereafter "Captive sparrows," to that of free-ranging sparrows. On 12-13 July, we captured nine adult male House Sparrows, hereafter "Wild sparrows," within a 16 km radius of the GVSU campus; 7/9 were captured in a barn at a dairy farm located less than 16 km northwest of the GVSU campus and the remainder were captured at an apartment complex less than 16 km southeast of campus. We do not know the breeding stages of the males we captured but all of them were in adult breeding plumage and had completely black beaks and there were numerous sparrow nests with nestlings in the rafters of the barn on the dairy farm. Wild sparrows were transported to the GVSU campus, measured, and placed individually into cages as described above and allowed to acclimate to captivity for 24 hr before we attempted to obtain semen samples from them.

On 14 July, we attempted to obtain semen samples from Captive and Wild sparrows and then randomly euthanized 10 Captive and seven Wild sparrows to examine their testes for sperm production and their seminal glomera for stored sperm (King 1981, Wolfson 1954). Sparrows were euthanized by over-anesthetizing them with isoflourane. Within 2 hr of euthanasia, testes were resected and weighed on an electronic balance to 0.001g. We compared the combined testes masses (CTM) of Captive and Wild sparrows. Despite previous evidence of left-right asymmetry in House Sparrow testes mass (Keck 1934), our preliminary analyses showed that there was no significant differences between the masses of left (0.044 ± 0.070 g SD) and right (0.036 ± 0.059 g) testes (paired $t_9 = 2.16$, $P = 0.06$) of either euthanized Captive or Wild sparrows (left testis: 0.354 ± 0.120 g; right testis: 0.339 ± 0.217 g; paired $t_6 = 0.31$, $P = 0.77$). We attempted to resect the seminal glomera from euthanized birds, but they were difficult to find in the Captive sparrows (see below). The left testes from three randomly chosen Captive sparrows and the left testes and seminal glomera from three randomly chosen Wild sparrows were fixed in formalin, embedded in paraffin, sectioned for histological examination, stained, and examined under a microscope for the presence of sperm cells.

Over the course of the sampling period the beaks of male Captive sparrows began to change, starting at the base, from black to horn-colored. Beak color is a secondary sexual characteristic in House Sparrows (Anderson 2006) and it has long been known that beak color in House Sparrows is directly correlated with testosterone levels (T) and testicular activity (Haase 1975, Keck 1933, Keck, 1934, Lofts et al. 1973).

After the birds were euthanized, we photographed a lateral view of each male's beak and used the image analysis software to determine the proportion of the beak that was black. We did this to examine the relationship between beak color and CTM of Captive and Wild sparrows.

We examined the data for normality and, where appropriate, used parametric and nonparametric statistical tests to analyze data using SPSS 10.0 for Windows (SPSS

2002). We removed several data points from correlation analyses when preliminary analyses showed them to be statistical outliers. These included (a) one measure of semen volume (8 μL) that was nearly fifty percent larger than the next largest volume and (b) two measures of sperm concentration that were an order of magnitude larger (107 sperm μL^{-1}) than the next largest sperm concentrations. All tests were two-tailed and differences were considered statistically significant at $P < 0.05$. Data are reported as means ± SD.

RESULTS

To examine the effects of captivity on sperm production we compared the sperm concentrations we obtained from Captive males on 15 June with those obtained on 12 July. The mean sperm concentration of 15 June samples (1,310,124 ± 2,139,669 sperm μL^{-1}) was significantly greater than those collected on 12 July (236,037 ± 969,956 sperm μL^{-1}) (Wilcoxon matched pairs, $z = -1.96$, $P = 0.05$). Furthermore, the sperm concentrations of 15 June samples were larger than those collected on 12 July for 16/17 (94%) of Captive males (sign test, $P = 0.04$). A significantly larger proportion (9/17, 53%) of 15 June samples from Captive sparrows contained sperm cells than did samples collected on 12 July (2/17, 12%) (Fisher exact test, $P = 0.03$). The proportion of semen samples containing sperm cells collected from Captive sparrows on 12 July was significantly smaller than that collected from Wild sparrows (7/9; 78%) on 14 July (Fisher exact test, $P = 0.0016$). Sperm concentrations (Spearman rank correlation, $r_s = -0.40$, $n = 59$, $P = 0.002$) obtained from Captive sparrows declined with the number of days that a male was in captivity.

Over the course of the sampling period the beaks of most Captive sparrows, starting at the base, progressively changed from black to horn-colored. All of the 10 Captive males that were euthanized had completely black beaks at the start of the experiment on 15 June. In contrast, their beaks were significantly less black on 12 July; mean proportion black = 0.74 ± 0.26, (paired – $t_9 = 3.21$, $P = 0.01$). For Captive sparrows, there was not a significant correlation between the proportion black on a beak and semen volume on 14 July ($r = -0.26$, $n = 10$, $P = 0.48$), but those with more black on their beaks had greater sperm concentration ($r = 0.66$, $n = 10$, $P = 0.04$) and we obtained more total sperm from them ($r = 0.65$, $n = 10$, $P = 0.04$). Moreover, Captive sparrows with more black on their beaks had greater CTM ($r = 0.61$, $n = 10$, $P = 0.06$).

On 14 July, a significantly larger proportion of the beaks of Wild sparrows was black (1.00 ± 0.0, n = 9) compared to the proportion of black on the beaks of Captive sparrows (0.74 ± 0.26, n = 10, range 0.28 – 1.00) (Mann-Whitney U = 10.5, P = 0.007).

The mean CTM of Captive sparrows (0.079 ± 0.128 g; range, 0.003 – 0.405 g) was significantly less than that of Wild sparrows (0.692 ± 0.326 g; range, 0.426 – 1.402 g) ($t_{15} = 5.44$, $P < 0.001$). Seminal glomera were easily found and resected in the Wild sparrows but were difficult to find and resect from Captive sparrows and so were not

weighed. Examination under the microscope of the left testes of three Captive (Captive No. 14 = 0.004 g, Captive No. 15 = 0.089 g, Captive No. 22 = 0.004 g) and three Wild males (Wild No. 35 = 0.58 g, Wild No. 36 = 0.25 g, Wild No. 39 = 0.31 g) revealed sperm in the testes of Wild but not Captive sparrows. The left seminal glomera of the same three Wild sparrows contained sperm cells.

We could not statistically examine the relationship between CTM and sperm production in Captive sparrows because we obtained semen containing sperm from only 2/17 males on 12 July. In contrast, CTM was not associated with semen volume ($r = 0.69$, $n = 7$, $P = 0.09$), sperm concentration ($r = 0.06$, $n = 7$, $P = 0.91$), or the total amount of sperm obtained ($r = 0.51$, $n = 7$, $P = 0.25$) from the seven euthanized Wild sparrows.

The Captive sparrow caged with a female from 31 May – 14 July stopped producing semen by 30 June. We could not obtain semen samples from him on 15 and 18 June and his semen samples on 22 June (volume = 4 µL) and 26 June (volume = 3 µL) lacked sperm cells. When the male was euthanized on 15 July his (a) beak was 28 percent black, (b) CTM was 0.003 g, and (c) left testis was devoid of sperm cells.

Captive and Wild sparrows were morphologically similar, but differed in mass on the days they were captured (Table 1).

Table 1
Comparison between the morphological characteristics of euthanized Captive (n = 10) and Wild sparrows (n = 7). Means ± SD are illustrated. U = Mann-Whitney U test.

Charakter	Captive Sparrow	Wild Sparrows	U	P
Bib area (mm^2)	392.72 ± 91.73	399.16 ± 80.87	32	0.81
Bill (mm)	14.05 ± 2.90	12.24 ± 0.56	18	0.11
Right tarsus (mm)	17.86 ± 2.74	19.07 ± 0.86	27.5	0.48
Right wing chord (mm)	75.60 ± 1.58	73.71 ± 1.70	16	0.07
Mass at capture (g)	25.79 ± 1.92	22.76 ± 2.04	7	0.01

DISCUSSION

Our results indicate that being held individually in captivity with repeated semen sampling was associated with decreased sperm production, testicular atrophy, and beak color change in male House Sparrows. This was surprising. First, Captive sparrows should have remained in breeding condition throughout the sampling period from 15 June – 12 July which coincided with the middle of the House Sparrow breeding season in west Michigan (Berger 1957). Second, House Sparrows have been bred, albeit with difficulty, in captivity (Baker 1995, Mitchell and Hayes 1973, Moreno-Rueda and Soler 2002) with greater breeding success in groups of House Sparrows caged together than in isolated pairs (Anderson 2006). Moreover, Hegner and Wingfield (1984) suggested that social facilitation may be essential for gonadal development in male House Sparrows

because they observed greater testicular recrudescence in males housed in flocks than in males housed in pairs. Thus, the decline in sperm production and testicular atrophy in Captive males may be associated with the lack of social interactions between them.

We think that T levels declined in Captive sparrows for several reasons. First, the decrease in sperm production in Captive sparrows suggests a decline in T because spermatogenesis is stimulated by T (Goes and Dolder 2002, Johnson 1986, Wingfield and Farner 1993). Second, the testicular atrophy of Captive sparrows suggests a decline in T because the size of House Sparrow testes, the primary source of T (Fevold and Eik-Nes 1962), is positively correlated with circulating T levels (Hegner and Wingfield 1986a, Hegner and Wingfield 1986b) as it is in other bird species (Denk and Kempenaers 2006, Garamszegi et al. 2005). House Sparrow testes remain at or near their maximum size during the breeding season (Hegner and Wingfield 1986b) when higher T levels are associated with competition for nest sites and mates (Hegner and Wingfield 1986a). Photoperiod is the most important external stimulus affecting testes development in House Sparrows (Kendeigh 1941, Riley 1937), although social interactions are also important (Hegner and Wingfield 1984). Captive sparrows were exposed to natural photoperiods but were kept from direct social interactions because each was caged alone. The testes and seminal glomera of Captive sparrows were significantly smaller than those of Wild sparrows also implying a decline in T in Captive sparrows. The differences in CTM between Captive and Wild sparrows paralleled those found between the testes of male House Sparrows during the nonbreeding and breeding seasons, respectively (Keck 1934). Moreover, the testes and seminal glomera of Wild sparrows contained sperm whereas the testes of the Captive sparrows we examined did not. This is additional evidence that T levels declined in Captive sparrows. Last, the decrease in black on the beaks of Captive sparrows over the course of the sampling period suggests a decline in T because beak color is correlated with T level (Haase 1975, Keck 1933, Keck 1934, Lofts et al. 1973) and is a reliable indicator of testicular activity (Kendeigh 1941). Beaks are black during the breeding season when T levels are high and become horn-colored during the non-breeding season when T levels are low (Hegner and Wingfield 1986a, b). Fevold and Eik-Nes (1962) found that a CTM of 0.005-0.008 g is necessary for deposition of melanin in the beak. Only one Captive sparrow had a CMT (0.003 g) below this threshold, and his beak had the least amount of black (28 percent). House Sparrows typically have a long breeding season that extends from mid-March to mid-September and males have black beaks during this period (Lowther and Cink 1992). The change in beak color of Captive sparrows and concomitant decrease in CTM are consistent with the hypothesis that T production declined during the time that sparrows were held captive.

Moreover, the testes of Captive sparrows decreased in size unusually early in the season (Berger 1957, Lowther and Cink 1992, Anderson 2006). The synchronous regression of gonad size has been observed in other captive non-domesticated wild birds

but usually in late summer (Wingfield and Farner 1979). Thus the timing of the nearly synchronous regression of testes size, as indicated by changes in beak color, in Captive sparrows was surprising because it occurred in the middle of the breeding season.

In House Sparrows, the stress of capture, confinement in small cages (Lynn and Porter, 2008), and handling (Lynn and Porter 2008, Rich and Romero 2001, Romero and Romero 2002) are all associated with the secretion of the steroid hormone corticosterone (CORT). Prolonged elevation of CORT may suppress reproduction in birds (Deviche 1983, Silverin 1986). Furthermore, the stress of captivity may be exacerbated by small cage size (Cancione et al. 2002, Lynn and Porter 2008). Indeed, short-term confinement (≤ 90 min) in wire cages smaller (18 cm x 18 cm x 18 cm) than those used in our study (see above) resulted in a marked CORT response in House Sparrows (Lynn and Porter 2008). While acute stress can result in short-term elevations of CORT (Wingfield and Kitaysky 2002), chronic stress typically results in prolonged elevation of CORT and is associated with significant changes in behavior and physiology (Wingfield et al. 1998) including gonadal atrophy (Wingfield 1994). The changes in behavior and physiology are likely due to the proposed reciprocal relationship between CORT and T (Greenberg and Wingfield 1987, Wingfield and Kitaysky 2002). Thus, the decrease in sperm production, testicular atrophy, and the change in beak color in Captive sparrows may have resulted from prolonged elevated CORT levels that were due the stress of captivity and frequent handling. This hypothesis may be tested with hormone assays.

Captive breeding of House Sparrows has been most successful when sparrows have been housed in cages that allowed each individual from 0.4 m^3 (Moreno-Rueda and Soler 2002) – 5.5 m^3 (Baker 1995) of space. Our birds, housed alone had 0.03 m^3 of space. Studies of captive breeding of House Sparrows report greater success in groups caged together than in isolated pairs, but captive breeding is difficult and fledging success is typically lower than that of free-living sparrows in the same area (Anderson 2006). The greater reproductive success found in groups of sparrows housed together implies that male House Sparrows may require physical contact to maintain sperm production. Our results imply that just seeing or hearing other House Sparrows in close proximity and the presence of nest boxes and nest material were not sufficient for Captive sparrows to maintain sperm production and black beak color, and by implication breeding season T levels. This contrasts with other studies (Dufty and Wingfield 1986, Feder et al. 1977, Pinxten et al. 2003) that demonstrated that social cues and the presence of nest sites and nesting material help stimulate gonadal activity in male birds.

Several aspects of the reproductive physiology of male birds allow us to exclude several alternative explanations for our observations. First, it is unlikely that the decline in sperm production in Captive sparrows was caused by the type of food we provided them. Captive sparrows were fed a commercial product specifically designed for birds that we supplemented with another product designed to enhance breeding by caged birds. Furthermore, the Captive sparrows were fed ad libitum, so it is unlikely that sperm

production declined because of a lack of food (Kendeigh 1941). In addition, experiments by (a) Meijer and Schwabl (1989) showed that access to food by captive male Kestrels (*Falco tinnunculus*) had little effect on the levels of T and luteinizing hormone the two hormones that most directly affect testes development and spermatogenesis and (b) Meijer and Langer (1995) showed that the amount of food consumed had little effect on sperm production in captive European Starlings so long as the amount of food consumed exceeded starvation levels.

Second, it is unlikely that the lack of physical activity negatively affected sperm production in Captive sparrows. Activity patterns had little effect on sperm production in the captive House Sparrows studied by Riley (1937) and Kendeigh (1941).

Third, repeated sampling per se is unlikely to have negatively affected sperm production and testes size in Captive sparrows. Sperm production is not affected by the frequency of ejaculation (Amann 1981). We sampled Captive sparrows every third day which should have allowed them plenty of time to "recharge" their sperm supplies (Bird and Laguë 1976) especially because free-ranging House Sparrows copulate frequently (Birkhead et al. 1994, Lowther and Cink 1992) and have relatively large sperm reserves (Birkhead et al. 1994). However, we found that sperm concentrations declined during the period Captive sparrows were held captive and that the testes of all the three Captive males that were histologically examined lacked sperm.

Fourth, we are unaware of any reports of testicular atrophy resulting from frequent ejaculation or sampling. However, handling Captive sparrows every third day may have resulted in chronically elevated CORT levels (Lynn and Porter 2008, Romero and Romero 2002) which ultimately resulted in a decline in T production and testicular atrophy. This possibility can be directly tested with hormone assays. Experiments in 2006 during which we attempted to obtain semen samples from captive male House Sparrows only once a week (Lombardo and Thorpe – unpublished) produced the same results as described here suggesting that male House Sparrows may especially sensitive to the stresses of captivity and handling (contra American Kestrels, Bird and Laguë 1976). Housing conditions had no effect on follicular development in female House Sparrows (Hegner and Wingfield 1984).

Last, we do not think that intrinsic differences between subpopulations (cf. Lambrechts et al. 1999) of House Sparrows in Ottawa County, MI were responsible for the differences between Captive and Wild sparrows in sperm production and testes size. All sparrows were captured within 16 km of the GVSU campus, so we think it was unlikely that some males stopped producing sperm while other males nearby continued to produce sperm.

In conclusion, our results show that being housed alone in captivity and repeatedly handled negatively affected sperm production, testes size, and beak color in male House Sparrows. We concur with Anderson (2006) that House Sparrows do not acclimate well to captivity and hypothesize that the difficulty in breeding them in captivity may stem

from the effects of captivity on CORT levels. This hypothesis can be directly tested with hormone assays. The question of why House Sparrows seem to be especially susceptible to the stresses of captivity and handling remains unanswered.

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MEETING ON THE DECLINE OF THE URBAN HOUSE SPARROW *Passer domesticus*: NEWCASTLE 2009 (24-25 FEB)

INTRODUCTION

The symposium on 'the status of the House Sparrow *Passer domesticus,* in the urban environment held during the 24th IOC aroused considerable interest. Following this it was agreed to set up a 'working group' to foster exchange of ideas among researchers concerned with this problem that is of considerable biological significance.

After the first meeting held in London 2007 (ISSP 31: 27-37), a second meeting was held in Newcastle. On the first day several talks were presented concerning the decline of the urban House Sparrow, the associated habitat and different monitoring techniques. On the second day a round table discussion was organized to recommend a general methodology for censusing, not only House Sparrows but also other members of the genus *Passer* that, in a least part of their ranges, occupy the urban environment: Spanish Sparrows *P. hispaniolensis,* Italian Sparrows *P.italiae* and Tree Sparrows *P.montanus.*

A standard methodology would allow the comparison of different urban populations over the extensive ranges of the four species.

Here we bring the abstracts of the talks given on the meeting. A protocol for censusing urban sparrows will be published later.

PRESENTATIONS ON THE FIRST DAY

1. The decline of the urban house sparrow – causes and potential conservation measures

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(e-mail: Chris.Orsman@rspb.org.uk), Nancy Ockendon (e-mail: nancy.ockendon@bto.org),
Bill Haines & Will Peach (e-mail: will.peach@rspb.org.uk)

Large and widespread declines in urban-suburban House Sparrow populations have attracted much media speculation as to possible environmental causes. Recent declines in England have been greatest in London (65% since 1994), the south east (-35%) and east (-27%). Evidence is emerging of reproductive failure caused by chick starvation and poor body condition of fledglings, implicating inadequate invertebrate availability as a potential limiting factor. We report the results of an ongoing supplementary feeding experiment being conducted in London, which is testing the hypothesis that food

availability limits reproductive success and population size of urban House Sparrows. The experiment involves feeding mealworms throughout the breeding season at 33 sparrow colonies spread across Greater London; since 2007 we have also been providing a year-round constant supply of high quality sunflower hearts. Population size and reproductive success are measured at these colonies and at a similar number of unfed (control) colonies. Preliminary results suggest that the supplementary invertebrate food has increased productivity, while in the most recent year of the study, there has been a slowing of the population declines on fed sites. We also consider which other environmental factors are likely to be limiting population recovery and recommend potential conservation measures that merit field testing.

2. The House Sparrow in Paris: results of a five-year monitoring

Frédéric Malher
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The decline of the HS in many European towns is now well documented (De Laet and Summers-Smith 2006). However, this decline is not general: there is no decline in Manchester nor in Berlin. Paris is famous among European ornithologists as a town with many sparrows: monitoring of its population of House Sparrow was decided in 2003 and we present here the results of the first five years of that work.

Parisian data

In 1962, JJ Barloy estimated the Parisian population at the best moment of the year at around 500 000 individuals, but that result is only based on a census of the nests along a 8 km-long and 100m-wide strip. In 2003, C. Galinet stated that only 320 000 individuals remained, but without any scientific publication. At the same period, a monitoring by transects in a part of Paris (Malher 2006) showed no decline.

The monitoring

Led by the Corif (*) and the LPO (**), a monitoring by point-counts began in 2003: each observer had to stay for 10 min, counting all the birds which could be seen. It was asked to describe the features of the environment. Around 160 points were counted at least 3 times during the 5 years.

Results

On a mean point, one could watch 4,7 sparrows in ten minutes: That means that the Parisian population of House Sparrow is still rather dense.

The map of relative density shows a very low density in the upper-class sectors of the West of Paris and a much higher density in the popular belt of the East of the town. A negative correlation has been found between the density of the House Sparrow and the social level (expressed by the property price of old buildings). A mean annual

decrease of 5.3% has been shown for overall Paris, but this moderate decrease comes from two different trends:
– a stability in 18 out 20 "arrondissements";
– a dramatic crash in two "arrondissements", respectively –47% and –29% per year.

Discussion

To explain the dramatic decline in the two arrondissements previously mentioned, we propose that it is a consequence of a social change, which is established in one of them and possible in the other one.

(*) Ornithological Center of the "Ile de France"
(**) League for the Protection of Birds

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3. First steps in conservation of the House sparrow in The Netherlands

Jip Louwe Kooijmans
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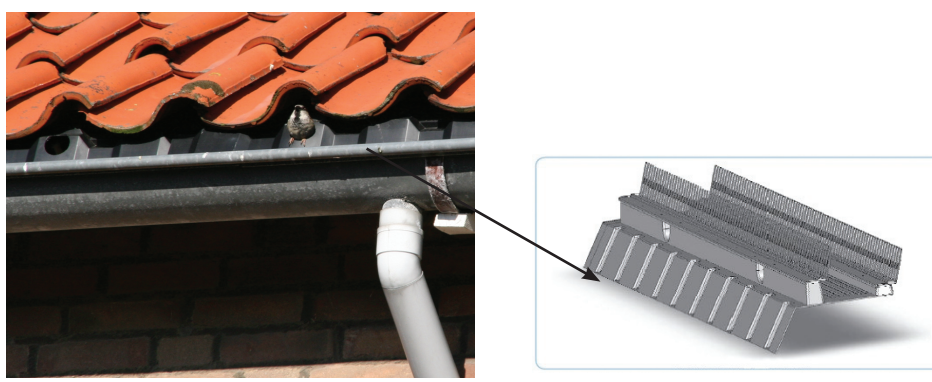

Fig. 1. Male house sparrow singing in the entrance of its nest in a Bird-loft

Introduction

The House Sparrow once was by far the most common bird in The Netherlands. Since 2004 it is red listed, the total decline is over 50%. Locally the House Sparrow has disappeared. In 2005 Vogelbescherming Nederland, the Dutch Birdlife Partner, started

a programme for urban bird species. Conservation of the House Sparrow is part of this programme.

Conservation programme of urban birds

For some birds, like the house sparrow, towns are the most important habitat. The programme is not only to stop the decline of the House Sparrow, but also to raise awareness among citizens for urban bird species. There is a close connection between urban bird species and citizens. Birds can symbolize the connection between citizens and nature, and improve the liveability of cities. The programme has two main goals:

- conservation of birds and their habitat within cities;
- raise awareness among citizens.

Housing for the House Sparrow

Disappearance of nesting facilities is not the only reason for the decline of the House Sparrow, but is seen as important. The use of eaves boards in the construction of houses, prescribed by an obligation from the Regulation on house construction ('het Bouwbesluit'), makes the roofs unsuitable as nesting site for House Sparrows. The eaves board prevents birds from getting under the roof, because nesting material will obstruct an optimal ventilation of the roof.

In cooperation with ComfortDak (a construction development company), Vogelbescherming Nederland, has developed new nesting possibilities for the House Sparrow. The product provides nesting space under the roof and meets the criteria for ventilation, as described in the Regulation on house construction. It is called the 'bird-loft' (vogelvide).

100 prototype bird-lofts have been tested in 4 cities for two years. SOVON developed a monitoring manual, with which the testing sites were monitored by local volunteers. They made one round every week along several observation points. At the observation points they watched the sites for 10 minutes and checked for bird-visits, transport of nesting material by birds, transport of food by birds or the sound of begging youngsters. The results were positive. On 3 locations the House Sparrows showed interest in the nesting sites. On 2 locations several pairs did actually built a nest and raise young! This made Vogelbescherming Nederland decide to continue this project. Last year the bird-loft was developed to a final product. This year it will be out on the market for construction companies and for the public.

Into practice

The decline of the house sparrow has raised a lot of attention in the media nationwide. A lot of local actions were started by the public. Not all of them were successful, but they all drew attention to the house sparrow and to urban birds in general. At Vogelbescherming Nederland we are aware that disappearance of nesting sites is only one problem that House Sparrows face in cities. But the bird-loft 'holds the message'

for citizens that conservation of the house sparrow needs action of people. All that the House Sparrows need can be provided by people in their own street: food (for adults as well as for young), shelter and nesting spots.

4. House Sparrow Conservation Scenario in India and Future Challenges

Mohammed Dilawar
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The presentation deals with House Sparrow Conservation Ecology in India and future challenges. It will cover the population status of House Sparrows in India. Conservation methods employed for conservation of House Sparrows in India. Need to gather scientific data in India and how it can be done.

Introduction of research methodology of proposed study on the decline of House Sparrows in Urban sub-habitats of India.

Help in the development research methodology and collecting data on House Sparrows as most of the European countries have been doing this for decades.

Future plans for conservation of House Sparrows in India. The conference will be very useful as it will help in the development of the House Sparrow conservation strategy, data collection, methods of analysis and establishing linkages and collaborations with international agencies and scientists.

Positive aspects and support from media and the public for the conservation of House Sparrows in India.

5. The Sparrows Passer spp.: news from Italy

Marco Dinetti
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After the "Meeting on the decline of the urban House Sparrow, *Passer domesticus*" (London, Institute of Zoology, February 2007), the "Progetto SOS Passeri" promoted by LIPU had some advances. First of all, the brochure "I Passeri" was published: it contain some popular chapters (birdwatching, causes of the decline, action to be taken in gardens, etc.) in order to raise public awareness, and also a scientific paper that draws a review of the status of Sparrows in Italy and in Europe.

We remember that four species of the genus *Passer* are living in Italy:

- House Sparrow *Passer domesticus* (in the Alps and in the cities of Aosta and Triest);
- Italian Sparrow *Passer italiae* (common species in cities and rural areas of the peninsula);
- Spanish Sparrow *Passer hispaniolensis* (in Sicily and Sardinia);
- Tree Sparrow *Passer montanus* (in countryside and suburbs).

About population trend in urban areas, data from the third edition of the urban breeding bird atlas of Florence (2007-2008) show a density of 46.2 pairs/sq. km (decrease of -20% respect to 1997-1998).

For Livorno preliminary results from the new urban breeding bird atlas (2006-2007, 58 units 0.25 sq. km out of 177 total = 13 sq. km out of 38 sq. km total) show a density of 67 pairs/sq. km (decrease of -53% respect to 1992-1993).

In the last ten years, data show a decrease in the urban populations of the Italian Sparrow of 50%, and this confirms the situation reported for the House Sparrow elsewhere in Europe.

About the possible causes of the decline, we look at specific actions on bird/window collisions: in collaboration with ornithologists from Switzerland and Austria a book was printed to give advice to planners and architects, and some collaboration was developed with motorway agencies to plan bird-friendly noise barriers.

With the collaboration of CISO (*Centro Italiano Studi Ornitologici*) we are suggesting a monitoring programme with standardized census methods (territory mapping with plotting on 1:2000 scale maps, quantitative urban bird atlas, line-transect lasting 30 minutes) be used by ornithologists, birdwatchers and citizen scientists.

Sparrows are a universal species with a strong appeal to the public, and are good indicators of the quality of the urban environment, the habitat in which most of us now live.

Recent zoogeographical comparisons have generated the hypothesis that the current population of Italian Sparrow of Crete (Greece) may have had a recent anthropogenic action, since it cannot be ruled out that they were introduced onto the Greek island -even deliberately- in historical times, possibly in the form of individuals of Italian origin. This hypothesis needs, however, to be confirmed by genetic studies on the Cretan population.

6. House Sparrow Densities in Different Habitats in a Small Town in NE England

J. Denis Summers-Smith
(e-mail: jdss@tribology.co.uk)

The House Sparrow is predominantly associated with the built-up urban environment. The term 'urban', however, embraces a number of different sub-habitats that require to be considered separately in terms of their significance to House Sparrows. This paper gives the results of the determination of the densities of House Sparrows in five different homogeneous urban habitats in the small town of Guisborough in NE England. The human population of Guisborough has increased from 8,000 at the end of World War II to a current total of 18,100 with the building of residential suburbs surrounding the old town centre, resulting in the creation of blocks of homogeneous urban habitat of different ages and types. This is a preliminary report on breeding season censuses of House Sparrows in five distinct urban areas.

House Sparrows are extremely sedentary birds that live in loose colonies, typically of 10-20 breeding pairs. Foraging for food for the nestlings takes place preferably within 100 m of the nest. I have listed in Table 1 the three environmental requirements that I consider are of most importance to the bird with a suggestion how these can be defined by readily determined characteristics of the particular environment.

Table 1.
Aspects of Environment Important to Urban House Sparrows

Requirement	Description	Defining Parameter
General	Built-up area	Housing density
Nest site and cover	Preferred site is hole in building, nest box or tree, but creepers on wall and thick hedge are also used	Housing age
Ford	Nestlings require invertebrates. Free-flying birds eat vegetable food, mainly seeds, but in urban areas these are often replaced by human scraps	Percentage of 'green' area

Table 2.
House Sparrow Densities in Different Urban Habitats in Guisborough (2008)

Site	Description	Date Built	Area Ha	'Green' %	Houses/ha	Sparrows birds/ha
Council Estate	Social housing	1950s	10	50	47.7	9.8
Rivers Estate	Middle-class sub-urban estate	1950s	14.4	60	14.7	1.6
Pine Hills	Ditto	1970s	30	60	14.2	1.7
Regency	Ditto	2000-2002	16	30	13.6	0
Hutton Gate	'Leafy, affluent suburb'	1950s-1970s	5	90	2.4	2 (1961-1979) 0 (1980-2008)

Results are given in Table 2. These preliminary results, that need to be repeated to take account of normal annual variations, suggest that the simplistic defining parameters that I have used can separate the different habitats in terms of their utilisation by House Sparrows, not only to monitor changes with time, but possibly also as a means of comparing urban areas in different countries with different urban cultures.

7. London House Sparrow Parks Project

Jacqueline Weir
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Recent research has suggested that a lack of invertebrate availability during the breeding season may be limiting chick survival in UK urban / suburban House Sparrow populations (Peach *et al.*, 2008). Ongoing research in London appears to support

this, possibly in addition to food supply limiting adult populations (Ockenden *et al*., unpublished).

A trial is being set up in London parks to investigate the effectiveness of different habitat management regimes in providing seed and invertebrate food for House Sparrows. The project is being run in partnership with eight Borough Councils and other organisations across London, with twenty parks involved.

Plots of three habitat management types are being set up in the parks, each paired with a control plot of the usual management regime (short amenity grass). The three treatments are:

– Long grass: a change in mowing regime to allow grass to set seed and remain long over winter. This will provide over-wintering habitat for invertebrates, and grass seed.
– Wildflower meadow: cultivation and sowing with appropriate meadow species, followed by management as a haymeadow. This will provide over-wintering habitat and a nectar source for invertebrates, as well as seed.
– 'Wildlife Seed Mix': cultivation and sowing with a mix of species based on agri-environment scheme Wild Bird Cover plots, to be re-sown annually. This will provide a nectar source for invertebrates and includes plants with a high seed load.

Each plot and its associated control area will be monitored for bird use (by all species), seed availability, and invertebrate abundance. Where present, existing House Sparrow breeding populations and their productivity will be monitored.

The project has gratefully received funding from SITA Trust, through the Landfill Communities Fund.

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8. The present status of the House sparrow in the Netherlands: do we still have to worry?

Guus (A.M.) van der Poel
(e-mail: amvdpoel@xs4all.nl)

The most recent data provided by SOVON (the Dutch BTO) concerning the status of the House sparrow in the Netherlands give reason for some conservative optimism. It is true that compared to 1980 the population has decreased by 50%, but since about 2000 winter point transect surveys and city breeding bird populations show no further decrease.

In 2007 I coordinated a survey in the Gooi- en Vechtstreek (a 12x15 km^2 area around the city of Hilversum). Sixty-seven people participated in the survey. They

were asked to provide food (a mixture of seeds and grain) on a paved surface in the neighbourhood of their homes on a daily basis for 14 days and to count the number of House Sparrows that were attracted to the food for 30 min. Time of day and place were fixed. The survey was performed between March 1 and April 15, just before the start of the breeding season.

The results show that House Sparrow populations in the smaller residential areas (villages and small cities with less than 18000 inhabitants) were still thriving (see fig.1). However, in the larger cities (Hilversum, Bussum and Huizen) far fewer House Sparrows were counted (see fig. 2). Compared to the smaller residential areas the number of count sites without any sparrows was three times as high, whereas the mean maximum numbers were three times as low. Compared to an earlier survey in the same area (1997/8) it seems that the situation in the smaller residential areas has remained stable. Due to a lack of participants from the centre of the larger cities it is difficult to compare both surveys there.

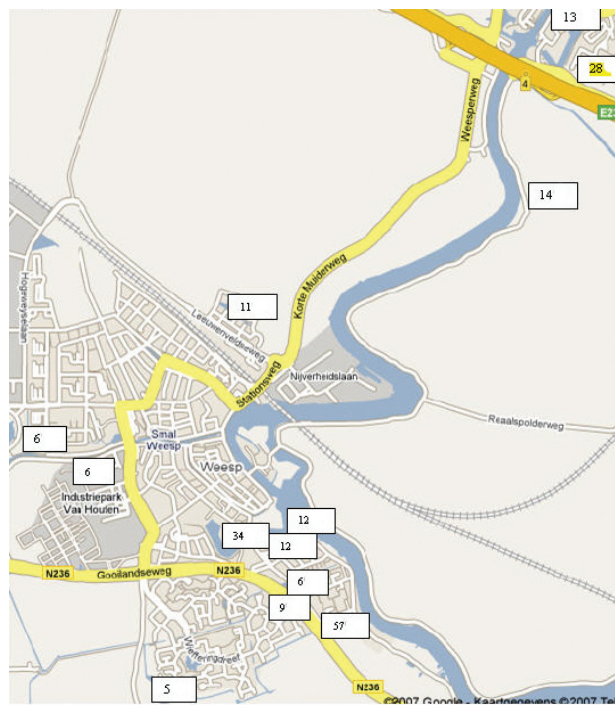

Fig. 1. Maximum numbers of House sparrows counted on sites in Weesp and Muiden. There were 13 count sites – average maximum number of House sparrows: 18.5 (range 5-57)

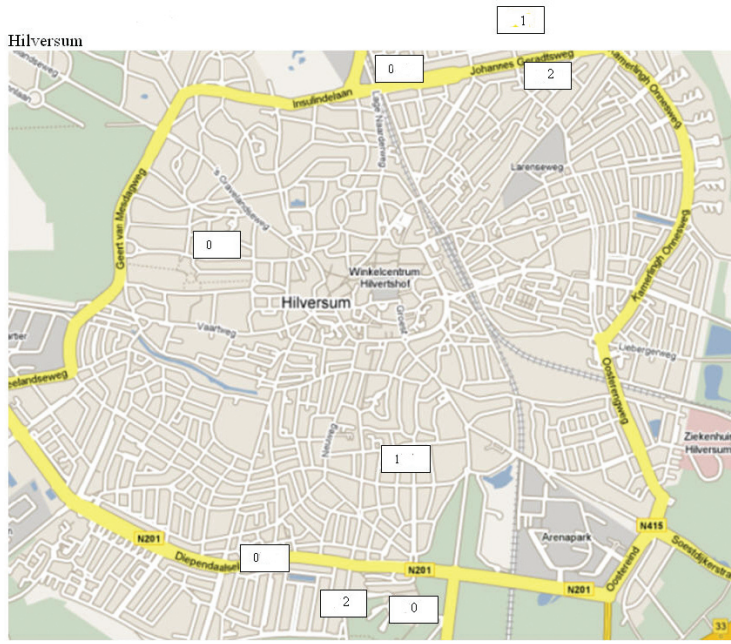

Fig. 2. Maximum numbers of House Sparrows counted on sites in the city of Hilversum. There were 8 count sites – average maximum number of House Sparrows: 0.75 (range 0-2)

9. London Sparrows are falling down… is a bug tripping them?

Daria Dadam
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The House Sparrow (*Passer domesticus*) has declined in London by 70% in the past 30 years, a trend reflecting the general decline of this bird in many large European cities. Several causes for this negative trend have been suggested, including lack of food, of nesting sites, increased predation and competition. However, none of these aspects could indisputably explain the decline of this passerine. The role of diseases was yet to be considered, despite their known role in population declines. This study runs alongside the RSPB London House Sparrow Project, and it aims at investigating the role of diseases in the decline of the house sparrow in London. During this project blood and faecal samples were collected from house sparrows at 12 sites across Greater London. Blood parameters, including haemoglobin, white blood cells, red blood cells, and fibrinogen, as well as parasite count from faecal samples were correlated with population trends and feeding regime of each site. Preliminary analyses show interesting trends between population status and intensity of parasite infection, and between haematological values and stages of the bird annual life cycle.

10. Relationships between home range size and nutritional condition of House Sparrows differ with degree of urbanization

Carl Van Gestel
(e-mail: Carl.Vangestel@UGent.be)

Both resource dispersion and habitat productivity hypothesis predict a negative association between nutritional condition and home range size. We investigated this relationship in House Sparrows (*Passer domesticus*) along an urbanization continuum in and around the city centre of Ghent, Belgium. We tracked 49 House Sparrows between October-December during three consecutive years. We found no support for the resource dispersion and habitat productivity hypothesis, but in contrast a positive relationship between nutritional condition and home range size in urban areas was shown, while suburban and rural regions lacked such a relationship. An analysis of the patch proximity index revealed a higher degree of isolation of suitable vegetation in the urban city centre, moderate connectivity in rural areas and high connectivity in suburban habitats. Mean home range size was smallest in urban, moderate in suburban and largest in rural regions. These findings support the view that habitat is becoming increasingly fragmented for urban House Sparrows, exceeding their gap tolerance and impede the potential to adjust their home range size, therefore restricting them to suboptimal habitats. These constraints might contribute to the extensive and dramatic decline in House Sparrow numbers in Western European cities during recent decades. Future urban projects should therefore ensure an optimal connectivity between habitat patches in order to reduce this additional stress in House Sparrows in urban city centres.

PRESENTATIONS ON THE SECOND DAY

During the second day some typical research projects were presented followed by a round table discussion on the need of a standardised protocol for determining House Sparrow populations in urban areas.

1. Temporal patterns in phenotypic markers: House Sparrows as a test case

Carl Van Gestel
(e-mail: Carl.Vangestel@UGent.be)

Conservation biologists are in need of effective indicators of environmental stress which could serve as an early warning system. The capacity to detect such stresses before populations are irreversibly affected would improve management decisions substantially. Two biomarkers that are nowadays frequently used are fluctuating asymmetry (FA) (small, random deviations from perfect bilateral symmetry) and ptilochronology (size of the growth bars on a feather).

Within this framework we want to compare historical estimates of FA values and growth bar sizes for House sparrows (i.e. based on museum specimens collected before population decline) with current (post-decline) ones, sampled from the same locations. So far we have measured 37 museum populations (1400 individuals) from a variety of Western-European cities and for a selection of this we would like to compare these results with those of contemporary populations. Locations we aim to sample are respectively Amsterdam (Netherlands), London (UK), Berlin (Germany), Frankfurt (Germany), Munich (Germany) and Hamburg (Germany). The idea is to catch +/- 20 birds from each of these locations, measure the tarsi and remove 1 tail feather (growth bars will be measured in the laboratory).

However, in order to accomplish this study we face several logistic problems as we do not have the appropriate licenses to ring birds outside Belgium. As this meeting will bring together researchers/conservation biologists from all over Europe we would like to take advantage of this opportunity to address the following topics:

– suggestions regarding a contact who has the appropriate license to ring House Sparrows in one of these locations (material/field assistant will be provided by us);
– suggestions to obtain a license to remove 1 tail feather from a House Sparrow.

2. Standardised Protocol for Carrying Out Censuses of House Sparrows in Urban Habitats: A Discussion Paper

J. Denis Summers-Smith
(e-mail: jdss@tribology.co.uk)

The serious decline of House Sparrows in urban areas, the most important habitat for the species, was first detected in NW Europe in the 1990s, but it now appears to be spreading to populations in other parts of the bird's range. This decline is not only an important biological phenomenon in its own right, but, as our neighbour in the urban environment, its decline may have important consequences as far as the human inhabitants are concerned.

Despite considerable research the reasons for the urban decline still elude and there is a need for a standardised protocol for determining House Sparrow populations in urban areas, not only as a means of monitoring the population, but in order to determine the status of the bird in other parts of its range for the insights that this might give into the underlying causes of the decline. This protocol is intended for House Sparrow populations in homogeneous urban habitats.

The following protocol is put forward for discussion.

1. Basis for census	1.1. Breeding season (Winter counts do not give consistent results)
	1.2. Active nest site (Active House Sparrow nests are easy to detect and can be assumed to represent two individuals)
2. Timing	2.1 First breeding cycle (House Sparrows are multi-brooded. Colonies tend to synchronise breeding.)
	2.2. Two-three hours between dawn and onset of human activity. (Detection is both visual and aural. This is easiest when conditions are quiet.)
	2.3. Three visits separated by 10-14 days. (Covers complete breeding cycle)
3. Description of urban area	3.1. Housing density (Buildings are the most important feature of urban area as far as House Sparrows are concerned.)
	3.2. Housing age (Age of housing gives indication of availability of nest sites and cover.)
	3.3. Approximate percentage of 'green' area ('Green' area gives indication of availability of food for both nestlings and free-flying birds. An approximate percentage can be obtained from satellite maps.)

4. Methodology	4.1. Census area 25 ha (Census area should cover more than one breeding colony. At low densities this may require increased census area to get meaningful result.)
	4.2. Mapping technique plotting active sites is preferred, but, where lack of accessibility makes this difficult, line transect may be used with 4 transects/25 ha square.

3. The new Dutch urban bird monitoring scheme MUS: 400 observers counting House Sparrows

Bram Aarts
(e-mail: Bram.Aarts@sovon.nl)

Monitoring of breeding birds in urban areas has never been popular in The Netherlands. Methods used so far in fieldwork (i.e. territory mapping) are expected to meet with difficulties in villages and cities, e.g. limited accessibility of many sites. Hence, knowledge on trends in built-up areas is scant, although meanwhile 16% of the Netherlands is urbanized. Moreover, several species typical of urban areas, like House Sparrow, have suffered major declines in recent decades and are now on the Dutch Red List. Therefore, in 2007 BirdLife the Netherlands and SOVON Dutch Centre for Field Ornithology designed a new monitoring project: 'Monitoring Urban Species' (MUS). Fieldwork and processing of data for MUS is less time-consuming than in traditional breeding bird surveys, and also suits less experienced birdwatchers. One of the three census rounds per year is conducted on a summer evening, in order to better record Swifts, House Sparrows and other species that are not very active at sunrise. First calls for participation proved successful; nearly 400 birdwatchers responded positively within a month after the project started. The results of the first two years of the MUS project will be presented. By combining the MUS census data with urban biotope information we are now constructing models to predict bird abundance in every Dutch city. Comparing actual census data on a local scale with these reference values may lead to more effective conservation measures.

More information is available through www.sovon.nl.

Guidelines for fieldwork

MUS has three main goals:

1. to monitor trends of all breeding birds in urban areas,
2. to monitor distribution of breeding birds and temporary changes in urban areas,
3. to describe densities of breeding birds in urban areas.

We aim to reach current bird counters as well as a new group for this network.

The fieldwork method:

- based on point counts,
- five minutes on each point,

- three counts during the breeding season:
  - o 1st between 1–30 April,
  - o 2nd between 15 May – 15 June,
  - o 3rd between 15 June – 15 July,
- the first two counts are between 30 minutes before sunrise till two hours after sunrise, last count is between 19.00 pm and sunset,
- all individual birds are recorded:
  - o Differences between male/female/juvenile are not noted,
  - o Birds flying by and not using the field are not recorded.
- no count circles or recording distances,
- participants chose their own count district [based on Dutch postal code system],
- Within this district 12 points are selected randomly by SOVON.
- Participant choses 8–12 points.

A small scale calibration study (distance sampling for the calculation of densities) is done by professionals.

4. House Sparrow monitoring in Belgium: the past versus the future

Jenny De Laet
(e-mail: famtrapp@scarlet.be)

Belgium is characterized by no House Sparrow monitoring in the past.

Just one trend analysis is known between 1950 and 2000 from an amateur in Kortrijk.

In 2002 the Flemish Bird Protection Association started with a monitoring survey for the general public. In the second weekend of April people were asked to count the chirping House Sparrows in their surrounding. In the mean time data concerning the habitat of the chirming House sparrows were asked. In 2007 the first five years were analysed.

The most important result concerns the fact that what we started as a long term monitoring on House sparrows is not possible with a general public survey because just 3% of the participants send their House sparrow data more than one year.

Therefore we intend to start with a vast staff of monitoring people and with support from the government.

In that way it is important to use the right methods so we can compare with other worldwide investigations.

Even more important would be to find at least a European basis for House sparrow monitoring.

ACKNOWLEDGEMENT

We are especially grateful to the RSPB for the hospitality in their office in Newcastle.

Also to the Flemish organisation ABLLO for sponsoring the meeting and giving me as their part-time assistant the opportunity to organise the meeting. ABLLO is especially active in working on a sustainable urban development and promoting the Lobe-city model to local authorities.

Finally we thank all the participants for their valuable contribution.

Intern. Stud. Sparrows 2009, 33: 33-37

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CONFERENCE ON SPARROWS, 20TH MARCH 2009, PISA, ITALY

"*Passeri in crisi ? Da 'pest'* a 'species of conservation concern': biologia, problematiche e conservazione dei passeri" was the title of the Conference on Sparrows held in Pisa (Italy) on 20th March 2009. The conference was organized by LIPU/BirdLife Italy together with Province of Pisa, Assessorato alla Difesa Fauna and the Centre "Enrico Avanzi" of the University of Pisa. Support came from CISO (Italian Centre for Ornithological Studies).

The idea to organizing this conference followed the establishment of the international Working Group on Urban Sparrows (WGUS) that had its second meeting last February 2009 in Newcastle, UK. The conference in Pisa was the occasion to join experts from 5 European countries (Poland, France, Norway, UK, and Italy) for discussing different aspects around the Sparrows: distribution, genetic, conservation, monitoring, breeding biology, habitat, health aspects, in urban as in rural environments. The conference was very successful. T he room was full with over 100 participants: ornithologists, researchers, environmentalists, technicians, administrators, students and hunters.

After the greetings of the politicians from Province of Pisa and University of Pisa, the introduction to the conference came with a videoclip given by J. Denis Summers-Smith, the man that has dedicated his life to the study of Sparrows. In the words of Denis "There is no genus of wild birds that has a closer relationship with man than *Passer*, the Sparrows. They occur in farmland, but their most characteristic relationship is that with man's built-up urban environment. In the 1970s, with the increasing urbanization of man providing more of the habitat to which this bird is uniquely adapted, I was predicting a successful future for the species. How wrong could I have been! In the time I have been studying the House Sparrow its status in the UK has changed from that of pest to a species of national conservation concern". In fact the House Sparrow is now undergoing a dramatic decline in numbers in large towns over much of NW Europe, leading in some cases to their virtual extinction. The urban decline started about 1990 and shows no sign of stabilizing as yet. More recent studies show that the decline is by no means uniform, but depends on the type of the urban environment, being most severe in the centres of large towns.

The topic of the first lecture "Synurbization - a new phenomenon in animal world" by Maciej Luniak of the Institute of Zoology, Polish Academy of Sciences in Warsaw defined three terms in their relation to animal ecology: "Urbanization" denotes changes

in landscape caused by urban development; "Synanthropization" means the coexistence of wild animal populations with humans and their existence in anthropogenic habitats; "Synurbization" is a particular case of synanthropization - it refers to the adjustment of wild animal populations to specific conditions of the urban environment.

In the second introductory presentation Marco Dinetti of LIPU/BirdLife Italy showed the "Sparrows Project" (Progetto SOS Passeri LIPU) underlining that some time ago Sparrows were considered agricultural "pest" species, while they are now listed as "SPEC" species of conservation concern. The Italian situation is quite particular, as four species of the genus *Passer* currently live in the country: House Sparrow *Passer domesticus* (in the Alps and in the cities of Aosta and Triest); Italian Sparrow *Passer italiae* (common species in cities and rural areas of the peninsula); Spanish Sparrow *Passer hispaniolensis* (in Sicily and Sardinia); Tree Sparrow *Passer montanus* (in countryside and suburbs). Recent advances of the "Sparrows Project" included the publication of the brochure "I Passeri" in order to raise public awareness in addition to some direct actions to prevent bird/window collisions through collaboration with motorway agencies to plan bird-friendly noise barriers. The monitoring programme was launched in collaboration with CISO (*Centro Italiano Studi Ornitologici*). The conclusion of the lecture was that Sparrows are an umbrella species with a strong appeal to the public and they are good indicators of the quality of the urban environment, the habitat in which most of us now live.

In the session on status and conservation, Marco Gustin, Patrizia Rossi and Claudio Celada of LIPU/BirdLife Italy recalled that in the last edition of *Birds in Europe* the European Sparrow and the Tree Sparrow were considered SPEC 3, while the Spanish Sparrow was considered "secure", and the Italian Sparrow was not considered. All these species are urban/suburban specialists, although the Spanish Sparrow and the Tree Sparrow are basically more "rural" compared to the House Sparrow and the Italian Sparrow. All four species are generalist with respect to trophic resources used. In the farm landscape, in particular for Spanish and Tree Sparrows, it would be desirable to promote agricultural policies that consider the ecological requirements of *Passer* species.

After, Guido Tellini Florenzano, Tommaso Campedelli, Elisabetta De Carli, Lia Buvoli and Guglielmo Londi by DREAM Italia in Poppi (Arezzo) and the Associazione Fauna Viva in Milan reported the relationships between Sparrows and the rural habitat, using the MITO2000 project database. The ecological models for *Passer montanus* and *Passer italiae* describe their presence and abundance with some ecological parameters, most of them linked to the agricultural environment. Particular attention was drawn to those variables linked with the structure of farms and with the intensity of agricultural practices.

The second session concentrated on distribution and genetic issues. Here the lecture by Stein Are Saether, Jo S. Hermansen, Thomas Borge, Elin Hjelle and Glenn-Peter

Saetre from Department of Biology, University of Oslo was "Molecular genetics of the Italian Sparrow: a separate species, a variety of House Sparrow or Spanish Sparrow, or a hybrid?". Indeed the taxonomic status of the Italian Sparrow is controversial: because the male plumage is intermediate between House Sparrow and Spanish Sparrow, Meise (1936) suggested that it is a stabilized hybrid form between these species. Without much further evidence subsequent ornithologists accepted the hybrid conclusion and the name given to the Italian Sparrow became a matter of personal preference. More interesting is the evolutionary history of the Italian Sparrow: did it really originate as a hybrid? Or did it evolve in isolation after recently becoming geographically separated from either House Sparrow or Spanish Sparrow? Or does it have a long history of its own, qualifying for status as a separate species? Analysing genetic variation using modern molecular methods provides objective ways of answering the Italian Sparrow puzzle. Results show that the Italian Sparrow is not a "species": not reproductively isolated from House and Spanish Sparrows, not a separate phylogenetic lineage (based on mtDNA), not a separate genotypic cluster (based on microsatellites). It seems to be a hybrid taxon (mosaic of House Sparrow and Spanish Sparrow genes, based on microsatellites). It probably arose in Italy from a hybrid swarm less than 20,000 years ago, before agriculture and Sparrows became common elsewhere in Europe. The Italian Sparrow may continue to exist because the Alps and Mediterranean are effective barriers to current gene flow.

After, Marco Masseti of the Department of Biology, University of Florence talked of the artificial diffusion of the House Sparrow in relation to its past and present capacity for invading new areas of distribution. In some of the geographic areas in which it is currently diffused, the House Sparrow may have been introduced even by passive transport (i.e. ship assisted). Recent zoogeographical comparisons have generated the hypothesis that the current population of Italian Sparrows of the Cretan area (Crete, Kasos and Karpathos, Greece) may have had a recent anthropochorous origin, since it cannot be ruled out that they were introduced onto the Greek islands -even deliberately- in historical times.

Kate Vincent of Baker Shepherd Gillespie in UK presented the breeding success of House Sparrows in urban areas. The reproductive success in a declining House Sparrow population was measured along an urbanization gradient in Leicester, to identify correlates of nesting success. During 2 out of 3 years, reproductive output was lower than the predicted threshold required for population stability. Years of inadequate reproduction were characterized by lower chick survival and body mass at fledging. Factors associated with reduced reproductive output included low ambient temperatures, extremes of rainfall, high levels of vegetable material in the diet, low aphid densities and high concentrations of air pollution from traffic.

From the Eastern Europe, Maciej Luniak and Andrzej Węgrzynowicz of Institute of Zoology, Polish Academy of Sciences in Warsaw presented the habitat distribution,

population changes and breeding success of House and Tree Sparrows in Warsaw. These species are still common in the city, but their abundance and habitat distribution show considerable changes over the last three decades. During the 2005-2007 breeding seasons, censuses covered 39 plots in three main habitats: housing estates (228 ha), urban parks (268 ha) and allotment gardens (62 ha). House Sparrows showed an average density in housing estates of - 44 pairs/10 ha, in parks - 3.8 pairs/10 ha and in allotment gardens - 1.6 pairs/10 ha. This reflects an average decrease of abundance of 39%. Tree Sparrow was most abundant in allotment gardens (38 pairs/10 ha, increase of 35%) and less so in parks (8.6, increase of 87%). Tree Sparrows have started colonizing housing estates most recently.

Frédéric Malher of Corif - Centre ornithologique Ile de France in Paris compared two methods used by non-professionals, during the same period, in order to describe the trend of the population of House Sparrow in Paris. These were monitoring by point-counts carried out by about 50 people and another by regular transects conducted by one person along some streets.

In the session on Biology and Habitat, Luciano Santini of Faculty of Agriculture, University of Pisa gave an objective assessment of the role of Sparrows in agroecosystems. In particular the author reported some information on the plants or parts thereof used by these birds as food.

Silvia Arena and Giuseppe Maria Carpaneto of Department of Biology, University "Roma Tre" in collaboration with Corrado Battisti of Nature Conservation Office of the Province of Rome outlined findings of their research on Italian Sparrows in a remnant Mediterranean wetland in central Italy.

The next session focussed on Population Monitoring of sparrows in urban and rural environments.

Francesco Mezzavilla, Katia Bettiol, Andrea Barbon, Saverio Lombardo, Stefano Morato and Elena Zampogno of the Associazione Faunisti Veneti and the Civic Museum of Natural History of Venice described the census of *Passer italiae* and *Passer montanus* breeding in the province of Treviso. Monitoring was carried out in 2004 and 2008 using the "Distance sampling" method.

Roberto Tinarelli of the AsOER - Associazione Ornitologi dell'Emilia-Romagna in Ozzano dell'Emilia (Bologna) reported the decline of Italian and Tree Sparrows in Emilia-Romagna in the Autumn of 2000. The results of counts using standardized methods in an area surrounding a solid waste discharge between 1997-2005 and information on the presence in fodder factories, night roosts in reed beds in wetlands and on the use of nest-boxes indicate a sudden population decrease of these species which happened simultaneously in several localities in the provinces of Bologna, Modena, Ferrara and Forlì-Cesena.

Fulvio Fraticelli of Fondazione Bioparco in Rome showed the preliminary data of the new Rome bird breeding Atlas. However since there are no data regarding density, it is not possible to use this tool to verify any decreases.

The status of Italian and Tree Sparrows in the cities of Tuscany covered by bird Atlas (Florence, Livorno, Pisa, Grosseto, Prato, Lucca) was given by Marco Dinetti of LIPU/BirdLife Italy and his collaborators Pietro Giovacchini of Gruppo Ornitologico Maremmano in Grosseto, Claudio Del Lungo of Municipality of Florence, Gaetano Licitra, Antonella Chesi, Claudia Chiari, Cinzia Licciardello and Mario Cenni of Environmental Protection Agency in Florence, Arianna Chines of Perlambiente in Lucca and Domenico Verducci of WWF Lucca. In particular, data about the distribution and abundance of these species was shown, and some relationships with land use and with different sources of environmental pollution were investigated.

The last session focussed on health aspects.

Renato Ceccherelli, Riccardo Gherardi and Gianluca Bedini of CRUMA-LIPU in Livorno indicated that the main causes of death for nestlings of Italian Sparrow brought to the bird recovery centre in the province of Livorno were similar to those obtained by Pinowski *et al*. in Poland.

Five posters were also presented at the Conference (the texts are published in the Proceedings).

Proceedings of the Conference are now printed and available: 116 pages, special issue of the journal "Ecologia Urbana" www.ecologia-urbana.com (Europe € 25,00). Ask to: info@edizionibelvedere.it

For obtain general information about the Conference send an e-mail to:
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SHORT NOTES

Ein Vergleich zwischen dem Norden der Niederlande (Leeuwarden) und dem Suedwesten (Rotterdam Bild I)

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DER EINFLUSS VOM WINTER 1978/1979 AUF VERSCHIEDENE HAUSSPERLINGS-POPULATIONEN

EINFUEHRUNG

Nach dem strengen Winter von 1978-1979 fiel im Norden der Niederlande auf, dass sich der Bestand an Haussperlingen stark verringert hatte. Die ersten diesbezueglichen Nachrichten liefen schon bald nach der ersten Periode starken Frostes ein. Waehrend der Schneebeseitigung wurden erfrorene Sperlinge aufgefunden. Einer der Beobachter berichtete, dass die Sperlings-Population, die er zu fuettern gewohnt war, von 20 auf 3 Exemplare zurueckgegangen sei. Man glaubte, dass sie dadurch verhungert waeren, dass grosse Schneemengen die Dachziegel, unter denen sie wohnten, zugedeckt hatten. Im diesbezueglichien Schrifttum wird dem Wintersterben der Haussperlinge wenig Aufmerksamkeit gewidmet. Summers-Smith (1963) zieht aus den Ringdaten die Folgerung, dass die Mortalitaet waehrend der Brutzeit am hoechsten sei. Heij (1985) kommt an Hand langjaehriger Beobachtung von geringten Hussperlingen zu dem gleichen Schluss.

Seit mehreren Jahren sammeln wir bereits Populationsdaten des Haussperlings. Erst nach einem langen ersehnten strengen Winter waren wir nun zu imstande zu kontrollieren, auf welche Weise diese Art einen solchen Winter uebersteht. Im Norden des Landes herrschte vom 14. bis zum 18. Februar eine extreme Wetterlage, waehrend dem Suedwesten diese Verhaeltnisse erspart blieben. Diese Wetterlagediskrepanz hat uns dazu veranlasst, die Poulationsschwankungen zwischien Leeuwarden und Rotterdam zu vergleichien (Bild 1).

Die Wetterverhaeltnisse im Winter 1978/1979

Dieser Winter laesst sich folgedermassen kurz beschreiben. Der November 1978: ein trockener, warmer Monat und dazu ziemlich sonnig und heiss. Der Dezember1978: ein duesterer Monat und ueberdies zu kalt und ausserordentlich nass. Der Januar 1979: viel zu kalt, zu duester und fast ueberall zu trocken. Der Februar 1979: ein kalter, duesterer Monat mit umgefaehr normalen Niederschlagsmengen. Der Norden hatte seit dem 14. Februar grosse Ueberlast infolge der Tatsache, dass Unmengen von Schneegestoeber

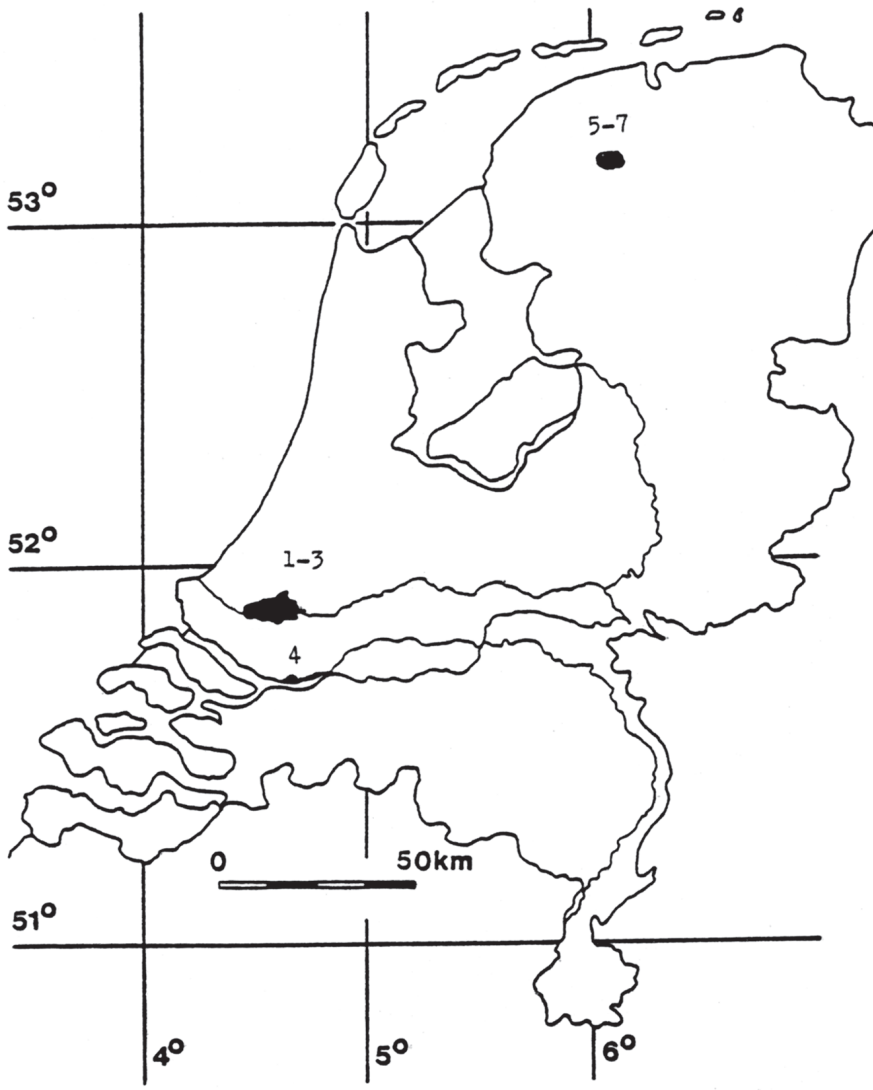
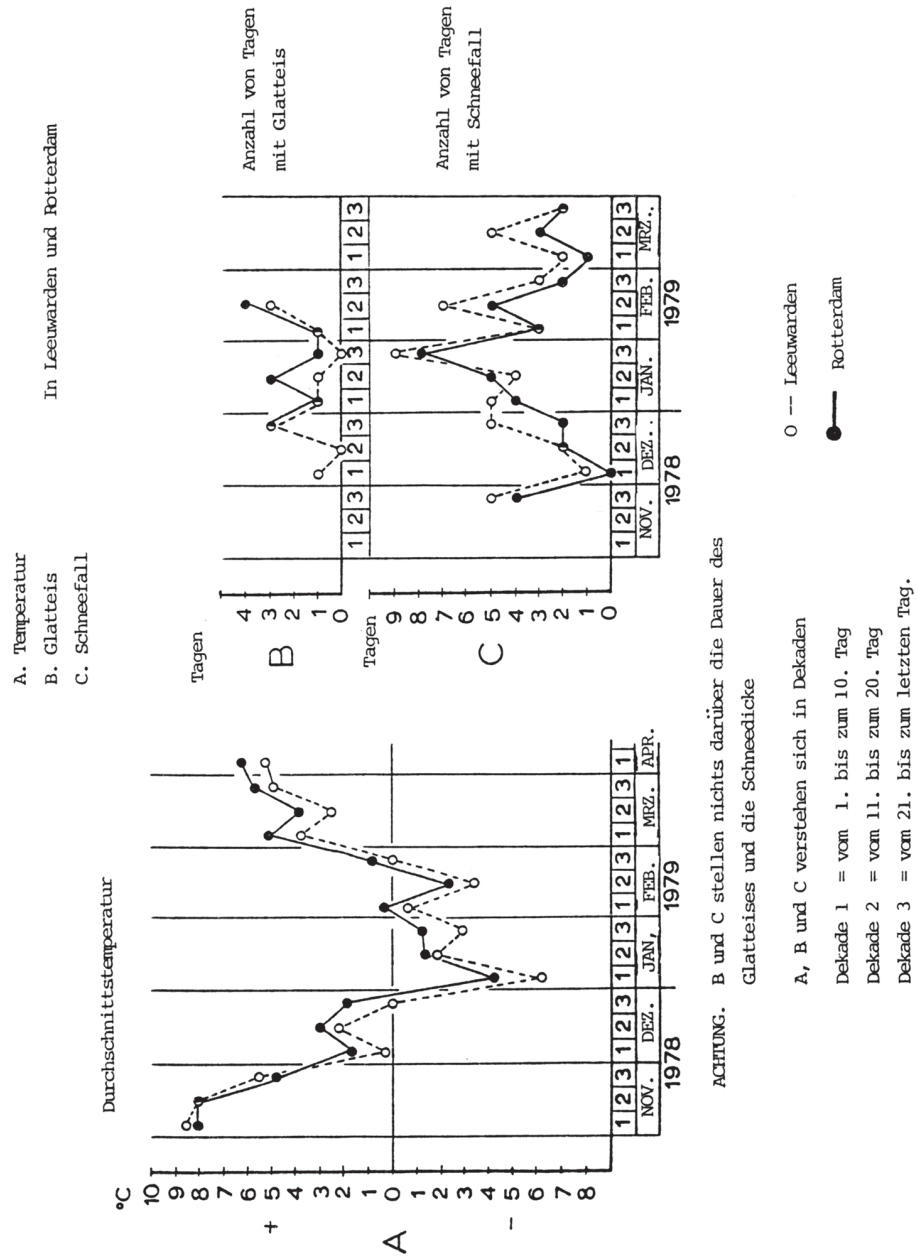


Bild 1. Landkarte der Niederlande
mit Populationen Rotterdam (1-3) Strijensas (4), Leeuwarden (5-7)

durch den starken Ostwind aus dem Norden der BRD herueberwehten. Der Maerz 1979: ein kalter, nasser und duesterer Monat.

Fig. 1. Winter 1978/1979



Bezeichnet den durchschnittlichen Verlauf dieses altertumlich strengen Winters. Der extreme Charakter dieses Winters im Norden ist jedoch nicht exakt darzustellen, weil nur durchschnittlichie Werte (wie z.B. die Temperatur) benutzt werden, und dadurch, dass die vom Wetterdienst (KNMI) vermittelte Messangabe fuer den Schneefall nicht fuer die Unmengen von Schnee, die im Norden gefallen waren, ausreichten (die Messangabe belaeuft sich auf 20 cm).

Hinsichtlich dieser extremen Verhaeltnisse im Norden werden wir uns jetzt mit einer Beschreibung begnuegen mussen.

Am 12. Februar gab es im Norden noch Frost, waehrend im Suedwesten schon Tauwetter herrschte. Waehrend der darauffolgenden Tage fielen in den Provinzen Groningen und Friesland sowie im Norden der Provinz Drenthe Unmengen von Schnee (gestoeber), welche von einem starken Ostwind fortgetrieben wurden. Bauernhoefe, Doerfer und sogar ganze Stadtviertel wurden voellig isoliert. Schneebeseitigung war vergebliches Bemuehen, da alles sofort wieder verschneite. Erst nach vier Tagen wurde der Schnee durch eine Glatteisschicht gefestigt. Schneehuegel in Hoehe von ueber 2 Metern waren eher Regel als Ausnahmne. Im mehreren Strassen von Leeuwarden waren die geparkten PKws lediglich auffindbar, wenn ein Stueck der Antenne ueber dem Schnee emporragte. Als das Glatteis den Schnee festhielt, muss es den Haussperlingen tatsaechlich sehr schwergefallen sein, in ihre Schlaefstaetten unter den Dachziegeln zu geraten, und vor allem: wieder herauszukommen. Fuettern hatte an jenen Tagen ueberhaupt keinen Zweck, weil alles sofort wieder zuwehte. Man kann also mit Recht behaupten, dass dieser Sachverlauf fuer den Haussperling, der im Winter fuer seine Nahrung fast voellig vom Menschen abhaengig ist, sehr unguenstig gewsen ist. Im suedwestlichen Teil des Landes wurden solche Szenen aber nicht gemeldet.

METHODE

Um die Differenzen im Populationsverlauf zwischen dem Norden und dem Suedwesten festzulegen, verfuegen wir ueber Daten von 7 Haussperlingpopulationen; drei in Leeuwarden, eine in dem „Hoekse Waard“ und drei in Rotterdam. Um zu bestimmen, wie gross die (Brut) Population in einem bestimmten Gebiet ist, haben wir uns entschieden, unsere Zaehlungen im Mai abzuhalten. Der Grund dafuer ist, dass es ab Juni bis frueh in den Winter viel herumtreibende, hauptsaechlich juvenile Voegel gibt. Diese Schwaerme kann man oefters an nahrungreichen Staetten (wie Getreide- und Unkrautfeldern) beobachten.

Winter kommt es wohl mal vor, dass Haussperlinge „gesellig schlafen“, im Efen oder unter der Dachrinne (statt unter den Dachziegeln). Diese Wintergruppen sind viel kleiner als die Schwaerme, die es im Herbst gibt. Erst im Maerz und April wird dann nach Neststaetten gesucht. Die erwachsenen Exemplare kehren bereits im Herbst zu ihren Neststaetten zurueck, nachdam sie zusamen mit den Juveniltieren mitgeschwaermt sind. Da muessen sie angekommen sein, bevor die Juveniltiere ihre Plaetze eingenomen

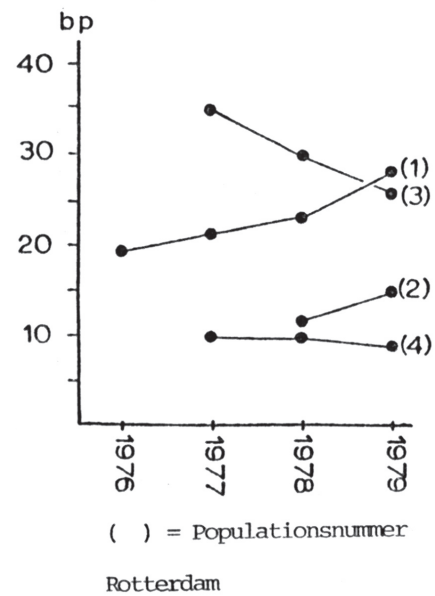
haben. Im Mai vollfuehrt der Haussperling keine Schwarmbewegungen mehr. Auch die Jungen des Vorjahrs haben dann, etwas spaeter als ihre Eltern, zu brueten angefangen. Indem wir im Mai die Anzahl von Brutpaaren zaehlen, schaetzen wir also moeglichst genau, wieviel Haussperlinge in einem bestimmten Revier leben.

ERGEBNISSE

Die gemessenen Daten der 7 Populationen sind nacheinander:

Populationen in Rotterdam und in dem „Hoekse Waard" (im Suedwesten) (fig. 2)

Fig. 2. Populationsverlauf in Rotterdam
(4) Hoekse Waard



Population (1) Hillegersberg (Vorort Rotterdams).
Anzahl von Brutpaaren:

1976: 19
1977: 21
1978: 23
1979: 28

Diese Vorortspopulation bruetet und schlaeft unter Dachziegeln. Die Zunahme wird durch eine feste Futterstelle verursacht. Der Winter '78/'79 hat diese Population nicht nachteilig beeinflusst.

Population (2) Spielplatz Rotterdam-Hillegersberg

Anzahl von Brutpaaren:

1978: 12
1979: 15

Diese Population bruetet in einem Efeu und zwischen Raendern. Durch den Nahrnugsmangel nach dem Sommer (wenn kaum noch Menschen den Spielplatz besuchen) gibt es hier im Winter sehr wenig Haussperlinge. Sie schwaermen dann aus nach den umliegenden Wohnvierteln, wo genuegend Nahrung zur Verfuegung steht . Auch hier: kein Rueckgang durch den Winter.

Population (3) Streichelzoo Rotterdam-Schiebroek

Anzahl von Brutpaaren:

1977: 35
1978: 30
1979: 26

Diese „Bauernhof-Populaton" (in einer Stadt!) bruetet und schlaeft in einer Strohscheume und unter Dachziegeln. Obwohl es hier eine Fuelle von Nahrung gibt, sinkt die Brutvogel-Population. Diese Senkung hat sich werscheinlich bereits vor dem ersten Jahr der Beobachtung eingesetzt, so dass sie nicht vom Winter 1978/1979 beeinflusst wonrden ist.

Die Zahlen in klammern entsprechen der Populationsnummer in den Fig. 2, 3 und 4.

Populationsnummer (4) Bauernhof in Strijen-Sas (Hoekse Waard)

Anzahl von Brutpaaren

1977: 10
1978: 10
1979: 9

Der Winter 1978/1979 koennte diese Population auf dem Lande etwas verringert haben. Auf dem platten Lande sind auch fuer Haussperlinge die Folgen von Schnee und Frost ernsthafter als in der Stadt (Stadtklima). Eine Senkung von nur einem Paar ist aber kein Anzeichen einer ausserordentlichen Wintermortalitaet.

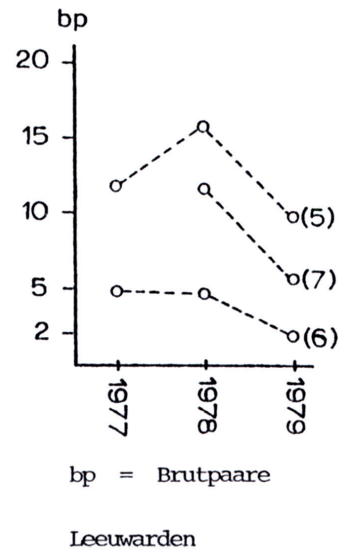
In Fig. 2 sind obenstehende Daten zusammengesetzt. Es ist offenbar, dass der Winter '78/'79 keinen nachteiligen Einfluss auf diese vier Populationen gehabt hat. Sehr wahrscheinlich ist diese Situation bezeichnend fuer den ganzen Suedwesten der Niederlande.

Populationen in Leeuwarden (Fig. 3)

Population (5) Huizumer Friedhof, Leeuwarden

Anzahl von Brutpaaren:

Fig. 3. Populationsverlauf in Leeuwarden



1977: 12
1978: 16
1979: l0

Im Fruehling und im Somer suchen diese Hauseperlinge nach Nahrung auf dem Friedhof, wo sie unter Dachziegeln brueten. Winters findet man sie zwischen den nahliegenden Hausern. Durch den Winter 1978/1979 hat der Haussperlingstand um ueber ein Drittel abgenommen.

Population (6) freistehendes Haus auf dem „Tijendijk“ in Leeuwarden.

Anzahl von Brutpaaren :

1977 : 5
1978 : 5
1979 : 2

Diese kleine Population befindet sich auf etwa 75 m entfernt von der Population Nr. 5. Austausch der Voegel ist moeglich, aber noch nicht festgestellt. Auch hier eine starke Senkung der Population, die auch unter Dachziegeln bruetet.

Population (7) Seriernwohungen in der „Verzetstraat“ in Leeuwarden.

Anzahl von Brutpaaren:

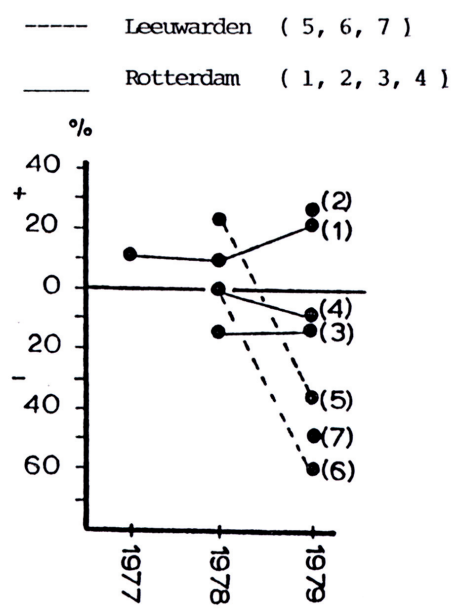
1978: 12
1979: 6

Eine richtige Stadtpopulation, die im Herbst haeufig auf Unkrautfeldern zu finden ist. Die Schlaf- und Neststaetten liegen unter Dachziegeln. Der Einfluss vom Winter 1978/1979 ist auch hier wieder ueberdeutlich. Der Populationsverlauf in Leeuwarden ist in Fig. 3 dargestellt. Recht auffaellig sind die Linien, die warscheinlich kennzeichnend sind fuer die gesamte Haussperlingpopulation im Norden der Niederlande.

SCHLUSSFOLGERUNG

Obwohl der Winter 1978/1979 fuer Mensch und Tier gleich anstrengend war, kann man von einer interessanten Situation reden. Nach niederlaendischen Masstaeben war der Winter ausserordentlich streng, und ueberdies gab es im Norden und Suedwesten der Niederlande eine verschiedene Wetterlage (Fig. 4). Die Resultate ergeben, dass unser

Fig. 4. Populationsgrösse im Vergleich zum Vorjahr in %



Haussperling einen strengen Winter (Frost) ohne Verluste uebersteht (siehe Fig. 2). Kommen dann extreme Umstaende (wie sehr grosses Schneegestoeber, anhaltendes Glatteis und starker Wind) hinzu, so stellt sich heraus, dass der Haussperling weniger winterfest ist (siehe Fig. 3).

Alle verfuegbaren Populationsdaten sind in Fig. 4 auffindbar. Daraus kann man ersehen, dass in Rotterdam (und in Kreis Rotterdam) der Durchschnitt ein weing ueber der Nullachse liegt; d.h. also ein kleines Wachstum. In Leewarden hat aber eine deutliche Senkung von durchschnittlich 50 Prozent stattgefunden. Leider sind keine Populationsdaten des platten Landes im Norden bekannt. Es ist aber wohl zu erwarten, dass dort noch staerker als in der Stadt der Rueckgang aufgetreten ist.

SUMMARY

In general House Sparrows *Passer domesticus* live rather well through severe winters in the Netherlands. It is interesting to find that in the severe winter of 1978-1979, during which a combination of strong winds, glazed frost and fine snow covered the feeding-sites and roosts with a thick layer of frozen snow, the number of House Sparrows in Leeuwarden (North-Netherlands) diminished by 50%. In Rotterdam (South-West Netherlands) where there was less wind, glazed frost and snow, there was no notably higher mortality during that winter.

Ich danke dem Wetterdienst (KNMI) fuer die Vermittlung der verarbeiteten meteorologischen Unterlagen und Herrn W. C. G. Cornelissen fuer die Ubersetzung ins Deutsche.

LITERATURANGABE

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points. Please remember that the captions in tables and figures should be self-explanatory. In other words, the reader should not have to read the manuscript text in order to understand the figures content!

– **Results** – should be described according to appearance of tables and figures in the text. Please indicate in the manuscript margin the place to insert the relevant table or figure. Reported data should include no more significant digits than the precision of the used methods warrants! Species names are to be typed with italics. Author's name of species must be given at the first citing of the species.

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References should be in following form:

1. Barkowska M., Pinowski J., Pinowska B. 2003 – The effect of trends in ambient temperature on egg volume in the Tree Sparrows *Passer montanus* – Acta Ornithol., 38:5-13.
2. Radkiewicz J. 1989 – (Distribution and number of the White Stork in Zielona Góra Provinnce in 1985) – Przyr. Środk. Nadodrza 1: 47-66 (in Polish).
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4. Indykiewicz P. 2006 – House Sparrow *Passer domesticus*, Starling *Sturnus vulgaris*, Tree Sparrow *Passer montanus* and other residents of nests of the White Stork *Ciconia ciconia* – In: The White Stork in Poland: studies in biology, ecology and conservation, Eds. P. Tryjanowski, T.H. Sparks, L. Jerzak, – Bogucki Wyd. Naukowe, Poznań.

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