Man-dependence of House Sparrows (Passer domesticus) in the Faroe Islands: habitat patch characteristics as determinants of presence and numbers

Sven-Axel Bengtson, Kirstin Eliasen,
Laura Mary Jacobsen, Eydfinn Magnussen

Abstract

The House Sparrow (*Passer domesticus*) began to colonize the Faroe Islands in the mid-1940s and occurs in most built-up areas. Breeding is confined to the discrete human habitations (settlements) that form a pattern of patches ("habitat-islands"). In 2002 all settlements were surveyed and the number of pairs of sparrows (total number *ca.* 2,700 pairs) and amount of vegetation ("green space") were estimated. The settlements ranged in size from 0.01 km^2 (a single farmstead) to 8.72 km^2 (the capital) and 68% of them (n=118) were occupied by sparrows. Patch occupancy was positively correlated with both area and amount of vegetation ($p < 0.001$) but not quite with the degree of isolation ($p = 0.15$). The latter was crudely scored as a function of distance to nearest

Dorete - her book, Annales Societatis Scientiarum Færoensis, Suppl. 52, pp. 227-243. Ed. by S. A. Bengtson, P. Buckland, P. H. Enckell and A. M. Fosaa. Faroe University Press.

settlement with > 10 pairs (a possible source area) and topography (mainly mountains and open sea). The patch variables area, human population, number of houses and houses were strongly intercorrelated. Abundance (number of pairs) of sparrows was positively correlated with the number of houses ($r = 0.84$, $p < 0.001$). In all but one of the settlements with < 10 houses sparrows were absent, and also in many of those with 10-60 houses where the scatter swas wide (no significant correlation $p = 0.25$). All but one of the settlements with > 60 houses supported sparrows and the correlation with abundance was highly significant ($p < 0.001$). The absence of sparrows in small settlements is discussed in terms of risks of associated with small populations such as stochastic extinctions, Allee effects, competition, and predation (incl. persecution by Man). Various anthropogenic effects on abundance of sparrows are discussed; *e.g.* age, type and conditions of buildings and the presence of gardens, cultivations, and plantations all contributing to shelter and food resources. The Faroese House Sparrow as a metapopulation is briefly discussed.

Introduction

Most populations are spatially structured in respons to landscape heterogeneity and patchiness of resources at various levels of scale. For species that have evolved specific habitat requirements that occur as discrete habitat patches this may result in a patchy distribution pattern, where at any given time, however, only a fraction of the suitable patches may be occupied; thus a metapopulation model. Among birds many species occupy discrete habitat patches („habitat islands“) on a local scale, *e.g.* the House Sparrow (*Passer domesticus*), which is a worldwide companion of Man and infrequently found breeding outside human habitations (Summers-Smith, 1988, 2005); hence, usually exhibiting a distinctly patchy geographical and local distribution. The House Sparrow has received considerable attention especially since the mid-1970s when the populations began to decrease dramatically in several north-west European rural, suburban, and in particular urban areas. This caused much concern and prompted intensive research that has generated a number of hypotheses in attempts to explain the decline (Crick, 2002; Summers-Smith, 2003; Anderson,

2006; De Laet and Summers-Smith, 2007). Previous studies have demonstrated a number of relationships between density of House Sparrows and *e.g.* human population density (Rand, 1956; Summer-Smith, 1963), conditions of buildings and hence availability of nest-sites (Deckert, 1969; Coleman, 1974; Heij, 1985), food supply (Summers-Smith, 1959), and amount of vegetation (green space) on breeding grounds (Heij, 1985). These and other habitat variables such as presence of predators (Tinbergen, 1946; Churcher and Lawton, 1987; Beckerman *et al.,* 2007) contribute to qualitative differences between habitat patches on a local scale; differences that may be amplified by climatic factors manifested by effects of weather conditions on recruitment (Ringsby *et al*., 1998; Saether *et al*., 1999; Ringsby *et al*., 2002).

Present study explores the association between certain patch properties (*i.e.* habitat quality) and the distribution (occupancy of suitable habitat patches) and abundance of the House Sparrow on the Faroe Islands. The House Sparrow first colonized the Faroes a few years prior to the Second World War, and within *ca.* 50 years it had spread to, and bred at least once in effectively all built-up areas (settlements), though not yet found breeding outside any of them; the total population in 2002 was estimated at *ca.* 2,700 pairs (Bengtson *et al*., 2004). We surveyed and subsequently estimated the number of breeding pairs in virtually all the settlements on the islands from the very smallest, solitary farmsteads to the capital of Tórshavn. The aim of the study was to analyse this snapshot picture to determine whether settlement area and isolation (*i.e.* traditional metapopulation parameters) and other variables more directly associated with human presence can predict patch occupancy and abundance of House Sparrows.

Material and methods

The islands and settlements

The Faroes consist of 18 islands (0.8 – 374 km^2; total area 1,399 km^2) that are separated by narrow straits or short stretches of water (Fig. 1); all islands are inhabited except for the smallest one (Lítla Dímun). Topographically the shorelines that are facing west and north are characterised by spectacular, pre-

cipitous cliffs. Inland the terrain consists of valleys, mountain ridges and upland hills; the northern islands being the most mountaineous (highest peak 882 m a.s.l.). The climate is pronouncedly oceanic with a mean temperature of 4 and 11°C during the coldest (January -February) and warmest (July) months, respectively. Mean annual precipitation varies locally (800-2,200 mm) and fog or strong winds frequently prevail.

All but one of the settlements are situated on the coast and constitute a network of distinctly discrete patches of land (infields) placed in a landscape (outfields) of more or less natural habitats (see Enckell *et al*., 1987; Enckell and Bengtson, 2010). In principle a settlement consists of a densely build-up area with some adjoining cultivated land (mostly for haymaking and potatoes) that is usually separated from the surrounding outfield by stonewalls or other kinds of fences. Hence, the boundary between infields and outfields is usually very conspicuous. There is no natural tree vegetation on the islands, but small plantations (mostly coniferous) occur in some of the settlements. We recognized 118 settlements (*i.e.* potential House Sparrow habitat patches) ranging in size from 0.01 to 8.72 km^2 and constituting 4.5 % of total island area. For names of islands and geographical position for some of the settlements mentioned in the text see Bengtson *et al.* (2004: Fig. 1).

Surveying the House Sparrows

The fieldwork was carried out intermittently between early April and mid-June. Each settlement was surveyed by slowly walking along the streets and lanes inspecting the entire area and plotting all House Sparrows seen or heard. Chirping males were readily located when openly pearched on top of roofs, eaves and in bushes and they were also heard when hidden and out of sight under roofings or inside buildings. We scrutinized gardens, cementaries, areas with weeds and dense vegetation, cultivations and allotments, warehouses, older building, backyards, enclosures for poultry (including ducks, and geese), and farmhouses. Particular attention was paid to birds moving in or out of sections already surveyed and to this end the configuration of many settlements proved helpful as several of the smallest ones are less than 100 m across and

many of the smaller and medium-sized ones consist of buildings along a single main street running parallel to the shoreline. In the larger settlements there are usually several parallel streets or a much more irregular network of roads. Each area was surveyed only once and the time spent ranged from some 15 minutes (a single farmstead) to several hours depending on area, complexity of habitation, number of sparrows and prevailing weather conditions. The largest settlements were divided into sections that were surveyed over two (Klaksvík and the large settlements on Suduroy) or several (Tórshavn) days. The estimates of number of pairs are considered conservative. However, the degree of accuracy of the surveys was not tested but the procedures were consistent and the methods, although being one-visit-surveys, were in reasonably good agreement with recommendations given by Summers-Smith (*in litt.*). Further information on the data collecting is given by Bengtson *et al*. (2004).

The patch variables

For each settlement, we collected various data considered biologically relevant and/or being potential predictors of presence and abundance of House Sparrows. Among the data collected some did not reach the qualitative requirements (*viz*. presence of domestic cats (*Felis catus*), Norwegian rats (*Rattus norvegicus*), and domestic fowl) and the following patch variables are included in this study:

(i) Settlement *area* (km^2) was obtained from the MapInfo computer program using the topographical electronic map for the Faroes (scale 1:20 000).

(ii) *Human population* (official statistics; Anon., 2002) and *number of households* (equivalent to number of electricity meters) were used as an overall measure of resources provided by human activities (*e.g.* nest-sites, shelter and anthropogenic food in terms of scraps, stores, gardening, cultivation and farming).

(iii) *Number of houses* (data from local municipal administrations) since buildings provide nest-sites and shelter and family houses are often associated with gardens and cultivated plots.

(iv) Amount of *vegetation* was scored (rich-medium-poor; denoted +1, 0, -1) taking into account presence of old, overgrown gardens with shrubs and a lush vegetation (providing both plant and animal food), occurrence of commons, allotments and open, often untidy patches with grass and weeds; *i.e.* green space.

(v) Degree of *isolation*. By assuming that the probablity of (re)colonisation and hence presence of House Sparrows is a function of isolation (distance and/or topography) from a potential source area arbitrarily defined as the nearest neighbour settlement with > 10 breeding pairs we used a three-scaled classification: (0) adjoining or marginally distant; *i.e.* effectively fused with the source area, which in a few instances has occurred when neighbouring settlement have expanded in size, (1) < 5 km to nearest neighbour, and (2) > 5 km from a source settlement, or separated by mountains higher than 300 m.

Treatment of data

The numerically described patch variable are interrelated; thus, human population, number of house holds, and number of houses are pairwise strongly correleted (Spearman correlations for untransformed and transformed data all give r = 0.96) and can effectively be used interchangeably and all 3 variables are correlated with settlement area (r = 0.87-0.89). In the following the number of houses is being used as the independent variable with respect to describing House Sparrow abundance. Since two of the settlements (Tórshavn and Klaksvík) are considerably larger than, and in all other variables deviate markedly from the others, and since the data includ a number of zero-values the correlation analyses were performed on arcsinh transformed data. Chi-square tests were used to analyse the association between patch variables and the presence of House Sparrows. The statistical analyses were carried out by using the SYSTAT 8.0 programme.

Results

House Sparrows were present in 68 % of the 118 settlements and found on all islands except on the relatively small one-

settlement islands Stóra Dímun, Koltur, Hestur, and Mykines, and on Fugloy where there are two settlement (see Bengtson *et al*. 2004: Figs 1 & 4). Furthermore, empty settlements (all in the range 1-38 houses; mean: 12) also occurred on 8 of the larger islands. As shown in Fig. 2 patch occupancy was positively correlated with both area and amount of vegetation ($p < 0.001$), whereas the negative influence of degree of isolation on occupancy was weak and not statistically significant ($p = 0.15$). The overall positive correlation between the number of houses and abundance of House Sparrows is highly significant ($r = 0.84$, $p < 0.001$); though by dividing the x-axis arbitrarily into three sections a different and more informative pattern emerges (Fig. 3). Only one of the settlements with < 10 houses held sparrows while among those with 10-60 houses there was a wide scatter and many settelements were empty while others held between 2 and 35 pairs and the correlation was not statistically significant ($p = 0.25$). In contrast, sparrows were absent in only one of the settelements with > 60 houses (Nes on Eysturoy with 71 houses) and a statistical correlation between number of houses and number of pairs was highly significant ($p < 0.001$).

Discussion

This study on the Faroes, a marginal area for the focal species, corroborates the close association between House Sparrows and Man (Summers-Smith, 1988). Besides, it elucidates some of the essential habitat requirements of the species *viz*. suitable nest-sites, shelter, and food resources provided by Man. Initially, the House Sparrow was much aided by Man in colonizing the Faroes (see Bengtson *et al*., 2004) and also the ensuing success is governed by anthropogenic factors. The Faroese House Sparrows are exclusively found breeding within human inhabitations and patch occupancy is, as elesewhere and for many other taxa (Hanski, 1999), influenced by patch area; *i.e.* size of settlement (Fig. 2). The number of houses in a settlement was found to be a key (but rather crude) determinant of the number of sparrow pairs. When the human population increases so does the number of house holds and buildings and consequenly also the area of the settlement.

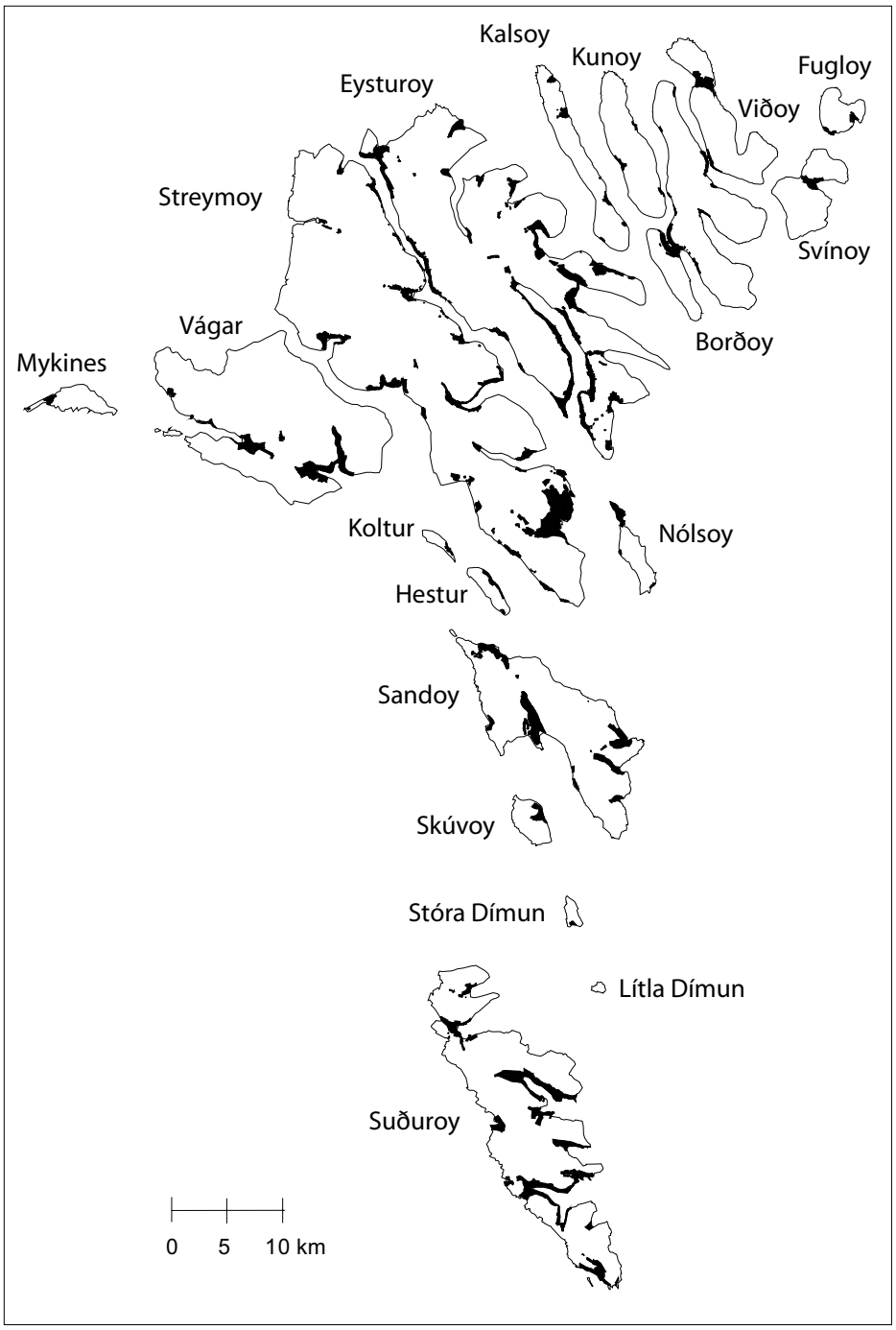


Fig. 1. The infield areas of the settlements in the Faroes. Numbers refer to the study sites (see Bengtson & Hauge, 1979, T=Tórshavn (the capital), and K=Klaksvík (the largest town on the northern islands).

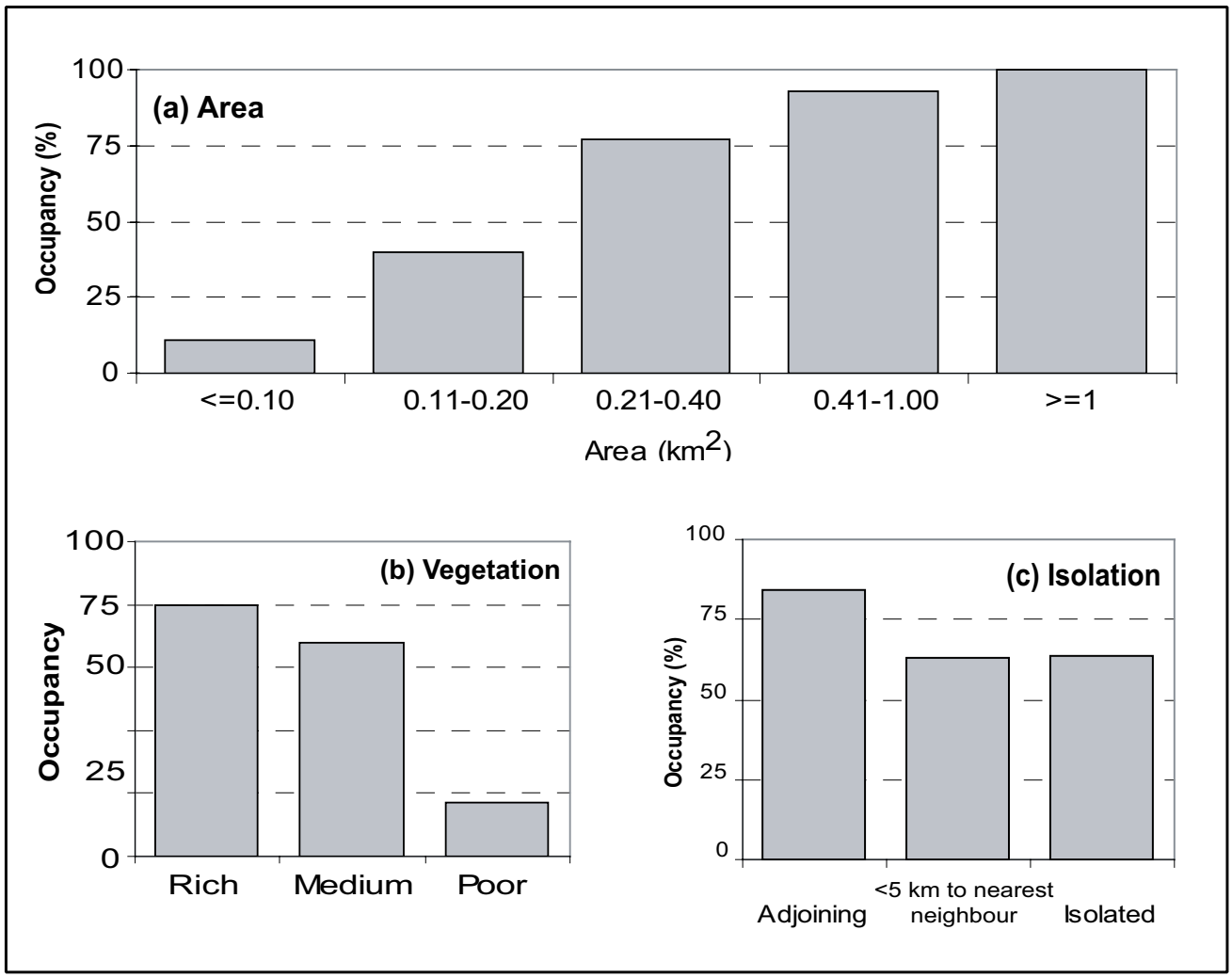
When, on the other hand, a settlement is being depleted of inhabitants its area remains more or less unchanged. Hence, there are, of course, many additional factors involved, such as age of the settlement (small, old and well-developed gardens) and architecture of the buildings (see Mason, 2006; Shaw *et al.,* 2008 and references therein; Murgui, 2009). With respect to the relationship between number of houses and House Sparrows there appears to exist some threshold values. Among

settlements with < 10 houses only one contained sparrows (Sydradalur on Streymoy with two houses and 3 pairs), while for settlements with > 38 houses (as shown by the actual data) the opposite prevailed, and all settlements but one were occupied. Sparrows were absent in many of the medium-sized settlements, (*i.e.* those with 10-60 houses) and there was no statistically significantly correlation between abundance and number of house; hence in sharp contrast to settlements with > 60 houses. This pattern may be due to the influence of a variety of patch variables, some mentioned above and others discussed below. Although we found no significant correlations between number of houses and vegetation ($r = 0.15$, $p > 0.05$) or degree of isolation ($r = 0.11$, $p > 0.05$) the scoring of these variables may not have been sensitive enough to capture essential differences in *e.g.* the suitability of the houses from the birds´ perspective. The House Sparrow seeks food and shelter within and in the vicinity of buildings, and the nests are usually placed under tiles or corrugated iron sheet or sod roofs, the latter being typical of Faroese architecture. Modern buildings provide fewer possibilites for the House Sparrows. For instance, on Fugloy the House Sparrow is considered a pest and is actually denied access to building by covering holes and openings with nets (Absalon Lydersen pers. comm.). The importance of suitable nest-sites is illustrated by what happened on the island of Nólsoy where a small, declining colony of House Sparrows quickly recovered and doubled in numbers when provided with nest-boxes (Jens-Kjeld Jensen pers. comm.). Thus, both number and condition of buildings is likely to influence patch occupancy and especially number of pairs in a settlement. The absence of House Sparrows in most small and many medium-sized settlements may be associated with a small population size; stochastic events, predation by domestic cats, and Allee effects (Allee, 1938). There are few potential predators on sparrows in the Faroes but domestic cats kill a substantial number (Magnussen and Jensen, 2009) quite conceivably could cause the extermination of small local populations; which, indeed, could also apply to the Faroese Wren (*Troglodytes t. borealis*) (Bengtson, 2001). Allee effects, leading to a collapse of the social environment when popula-

tion size drops below a certain level, have also been suggested to explain the decline of House Sparrows (Summers-Smith, 2005). As to possible effects of competitors, Williamson (1945) suggested that the House Sparrow and the Faroese Starling (*Sturnus vulgaris faeroensis*) may compete for nest-sites; the latter being ubiquitous and abundant in the islands. As to the larger settlements, these contain proportionally more public parks, allotments, plantations, warehouses, food merchandizing, public litter bins, fishing industry and other things typical of urban habitats and potentially useful to the House Sparrow (*e.g.* Gilbert, 1989; Wilkinson, 2006; Chamberlain *et al.,* 2007; Skórka *et al.,* 2009).

The House Sparrow usually avoids woods and plantations (Roselaar in Cramp & Perrins 1994) and the statistically significant effect of vegetation on the occurrence of sparrows was, for obvious biological reasons, expected as House Sparrows were frequently seen in overgrown, old gardens feeding on buds of ornamental bushes, on seeds on the ground, and on insects amongst herbs. They were also commonly seen on patches of cultivations and wasteland, less frequently in newly built-up areas. The only plantation that attracted substantial numbers was the one in central Tórshavn, possibly because of the presence of ponds with ducks that were regularly being fed by people.

The vegetation score is not entirely independent of the number of houses, and old buildings surrounded by gardens with lush vegeation are commonplace and maintained in most settlements. The settlement Tjörnuvík, albeit small (0.14 ha and 27 houses) and relatively isolated at the northern end of Streymoy, may be taken to illustrate the interaction between houses providing suitable nest-sites and the existence of rich vegetation. Suitable old family houses and farm building occur but no House Sparrows were recorded, probably due to the recent removal of shrubby and untidy vegetations and garbage. Although detrimental to the House Sparrows such action awarded Tjörnuvík the titel of being the cleanest settlement in the Faroes. Other studies have suggested that the decrease in numbers of House Sparrows in many urban areas in Europe is associated with a reduction in green patches and



thereby food resources, especially insects (Summers-Smith, 1999). Hence, there appears be a socioeconomic component to the occurrence of House Sparrows in the Faroe Islands as suggested for other regions in north-western Europe (Shaw *et al.*, 2008).

Many empirical and theoretical studies of various taxa have demonstrated effects of isolation on patch occupancy (see Hanski, 1999). At first sight the occurence of House Sparrows in the Faroese settlement seems to be consistent with such a pattern. House Sparrows were absent on the relatively distant small islands of Mykines, Fugloy, and Stóra Dímun and also in several semi-isolated settlements such as Saksun, Tjörnuvík, Árnafjördur, Múla, Tröllanes, Gásadalur, Skarvanes, and Vikarbyrgi (see Bengtson *et al.*, 2004:Fig 1). However, the influence of isolation on patch occupancy was weaker than

Fig. 2. Patch occupancy (n = 118) of House Sparrow in the Faroe Islands as an effect of (a) area, (b) amount of vegetation, and (c) degree of isolation.

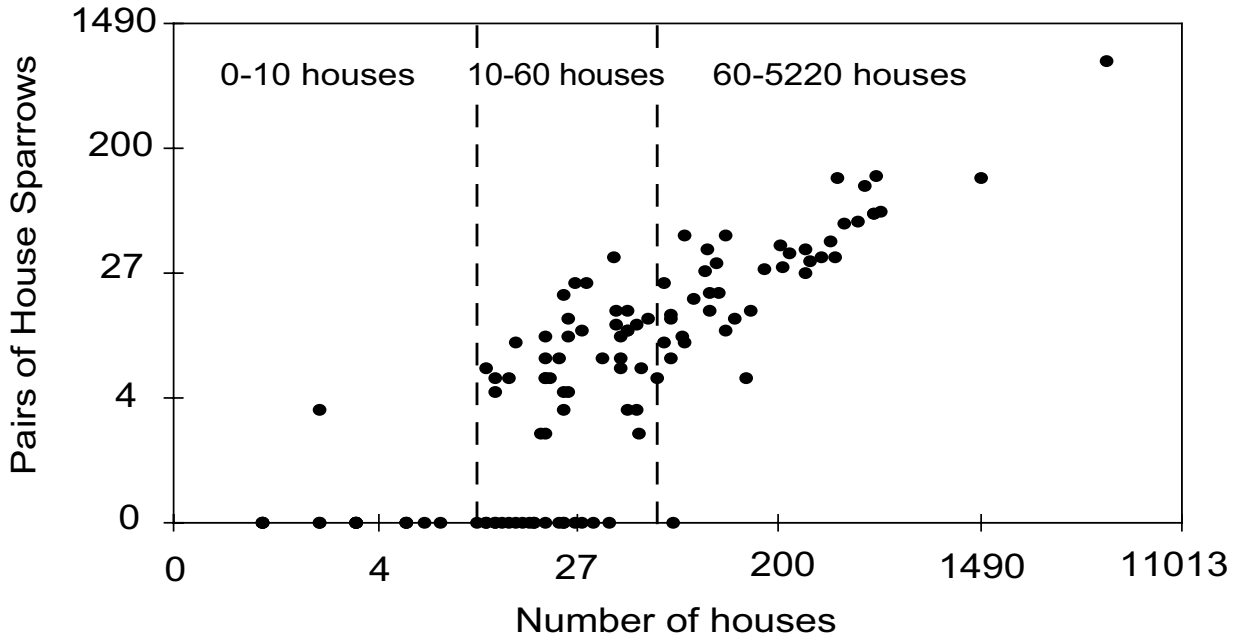


Fig. 3. Relationship between arcsinh transformed data for number of house and estimated number of pairs of House Sparrow in the Faroe Islands in habitat patches with (a) < 10 houses, (b) 10 - 60 houses, and (c) > 60 houses.

expected (Fig. 2) and the association between degree of isolation and number of pairs was not statistically significant. Possibly the index of isolation employed in this study is not sensitive enough, or does not take into account the pertinent criteria. A House Sparrow is capable of flying (and possibly occasionally does so) from one end of the archipelago to the other in a matter of a few hours, which makes predictions about dispersal and effects of isolation exceedingly difficult (Lewis, 1997). However, in practice House Sparrows is highly sedentary (Summers-Smith, 1988, Cramp & Perrins, 1994), as is also convincingly shown by ringing recoveries of Faroese sparrows (Magnussen and Jensen, 2009). In fact, of 225 Faroese recoveries of House Sparrows only two were made outside the settlement where they had been ringed; from Nólsoy they had crossed over to Kaldbak (20 km) and Tórhavn (4.5 km), respectively. House Sparrows colour banded in Tórshavn in late winter and early spring were, during the following breeding season, mostly sighted within 500 m (max. *ca.* 1600 m) of the place where they were first captured (Eliasen and Jacobsen, 2002), which is consistent with other studies (see Cramp & Perrins, 1994).

In a metapopulation context a fraction of suitable habitat patches is expected to be unoccupied at any given time. The

recurrent question is how to know that a patch is suitable or not at any particular time. To begin with, we assumed that all the settlements, irrespective of size, were suitable, though the observation that nearly all 10 patches < 0.1 km^2 were unoccupied indicates otherwise. For the remaining 28 unoccupied patches ranging in size from 0.1 to 0.57 km^2, we know that at least 14 of them have been occupied once or on several occasions in the past. Consistent with general theory it is the small local populations that are most prone to extinctions due to, for instance, persecution by man (on Fugloy and Stóra Dímun), habitat destruction (the „keep-your-village-clean" programme in Tjörnuvík, and the pulling down of an old, delapidated building on Hestur), and perhaps primarily demographic and environmental stochasticity. In the absence of adequate data on local demography and dispersal the presence of sink-source populations (Pulliam, 1988) and rescue effects (Brown and Kodric-Brown, 1977) on a hypothetical Faroese House Sparrow metapopulation will be no more than speculations. Tórshavn alone supports a network of patches with colonies of House Sparrows that comprises about one-third of the total Faroese population (*ca.* 810 pairs; see Bengtson *et al*., 2004). Hence, Tórshavn may by itself constitute a metapopulation and at the same time supply other settlements with immigrants. Similar mainland-island situations, with one or several large populations with a negligible risk of extinction surrounded by smaller populations (Harrison, 1991), may exist on the northern (Klaksvík, 125 pairs) and southern islands (Vágur and Tvöroyri, each 125-130 pairs), in the west (Sandavágur and adjacent Midvágur, together 95 pairs), and in central parts of the Faroes (Runavík, 110 pairs). The geographical distribution of these presumed House Sparrow strongholds may be related to the early stages of suggested multiple colonizatione of the islands (Jensen & Kampp, 1997; Bengtson *et al*., 2004). However, with respect to the concept of sinks and sources, abundance is not necessarily a good indicator of between-patch differences in reproductive success (Pulliam, 1988, 1996). Moreover, studies of a metapopulation of House Sparrows on islands in northern Norway have demonstrated spatiotemporal asynchrony in local demography re-

lated to weather conditions (Saether *et al.*, 1999, Ringsby *et al.*, 2002).

Acknowledgements

We gratefully acknowledge the assistance of several islanders (mentioned in the text) and in particular the help and information given by Mr. Jens-Kjeld Jensen and the logistic support of Dr. Dorete Bloch and the families and friends of KE and LMJ. The study was supported by the Faculty of Science and Technology (Náttúruvísindadeildin) at the University of the Faroe Islands.

References

Allee, W.C. 1938. *The Social Life of Animals*. Norton, New York.

Anderson, T.R. 2006. *Biology of the ubiquitous house sparrow*. Oxford University Press, Oxford.

Anon. 2002. *Álmanakkin*. N.H. Jacobsen Bókhandil, Tórshavn.

Beckerman, A.P., Boots, M. and Gaston, K,J. 2007. Urban bird declines and the fear of cats. *Animal Conservation* 10:320-325.

Bengtson, S.-A. 2001. Breeding distribution and numbers of wren (*Troglodytes troglodytes*) in the Faroe Islands. *Fródskaparrit* 49:127-139.

Bengtson, S.-A., Eliasen, K., Jacobsen, L.M., and Magnussen, E. 2004. A history of colonization and current status of the house sparrow (*Passer domesticus*) on the Faroe Islands. *Fródskaparrit* 51:237-251.

Brown, J.H. and Kodric-Brown, A. 1977. Turover rates in insular biogeography: effect of immigration on extinction. *Ecology* 58:445-449.

Chamberlain, D.E., Toms, M.P., Cleary-McHarg, R. and Banks, A.N. 2007. House sparrow (*Passer domesticus*) habitat use in urbanized landscapes. *Journal of Ornithology* 148:453-462.

Churcher, P.B. and Lawton, J.H. 1987. Predation by domestic cats in an English village. *Journal of Zoology, Lond.* 212:439-455.

Coleman, J.D. 1974. The use of artificial nest sites erected for Starlings in Canterbury, New Zealand. *New Zealand Journal of Zoology* 1:349-354.

Cramp, S, and Perrins, C.M. 1994. *The Birds of the Western Palearctic*. Vol. VIII. Oxford University Press, Oxford.

Crick, H.Q.P., Robinson, R.A., Appleton, G.F., Clark, N.A., Rickard, A.D. 2002. *Investigation into the causes of the decline of Starlings and House Sparrows in Great Britain*. British trust for Ornithology (BTO), Thetford.

Deckert, D. 1969. Zur Ethologie und Ökologie des Haussperlings. *Beiträge zur Vogelkunde* 15:1-84.

De Laet, J. and Summers-Smith, J.D. 2007. The status of the urban house sparrow *Passer domesticus* in north-western Europé: a reviw. *Journal of Ornithology* 148 (Suppl.2):S275-S278.

Eliasen, K. and Jacobsen, L.M. 2002. Gråspurvens udbredelse og antal på Færøerne set ud fra et metapopulations perspektiv. *NVDrit* 12:1-63.

Enckell, P.H,, Bengtson, S.-A., and Wiman, B. 1987. Serf and waif colonization: different patterns in distribution and dispersal of invertebrate species in settlements in the Faroe Islands. *Journal of Biogeography* 14:89-104.

Enckell, P.H. and Bengtson, S.A. 2010. Both size and money matter: màrkatal and invertebrate species richness in Faroese infield areas. *Fródskaparrit* 52.

Gilbert, O.L. 1989. *The Ecology of Urban Habitats*. Chapman and Hall Ltd, London.

Hanski, I. 1999. *Metapopulation Ecology*. Oxford University Press, Oxford.

Harrison, S. 1991. Local extinction in a metapopulation context: an empirical evaluation. *Biological Journal of the Linnean Society* 42:73-88

Heij, C.J. 1985. *Comparative ecology of the House Sparrow Passer domesticus in rural, suburban and urban situations*. Thesis, University of Amsterdam

Jensen, J.-K. and Kampp, K. 1997. Gråspurven på Færøerne. *Dansk Ornithologisk Forenings Tidsskrift* 91:74-78.

Lewis, M.A. 1997. Variability, patchiness, and jump dispersal in the spread of an invading population. *In*: Tilman, D. and

Kareiva, P. (eds). Spatial Ecology, pp 46-74. Princeton University Press, Princeton, New Jersey.

Magnussen, E. and Jensen, J.-K. 2009. Ringing recoveriews of house sparrow (*Passer domesticus*) in the Faroe Islands during the years 1963-2007. *Fródskaparrit* 57:182-189.

Mason, C.F. 2006. Avian species richness and numbers in the built environment: can new housing developments be good for birds? *Biodiversity and Conservation* 15:2365-2378.

Murgui, E. 2009. Seasonal patterns of habitat selection of the House Sparrow *Passer domesticus* in the urban landscape of Valencia (Spain). *Journal of Ornithology* 150:85-94.

Pulliam, H.R. 1988. Sources, sinks and population regulation. *American Naturalist* 132:652-661.

Pulliam, H.R. 1996. Sources and sinks: empirical evidence and population consequences. *In*: Rhodes Jr., O.E., Chester, R.K. and Smith, M.H. (eds). Population dynamics in ecological space and time, pp 45-70. University of Chicago Press, Chicago.

Rand, A.L. 1956. Changes in English Sparrow populations. *Wilson Bulletin* 68:69-70.

Ringsby, T.H., Saether, B.E., and Solberg, E.J. 1998. Factors affecting juvenile survival in House Sparrow *Passer domesticus*. *Journal of Avian Biology* 29:241-247.

Ringsby, T.H., Saether, B.E., Tufto, J., Jensen, H., and Solberg, E.J. 2002. Asynchronous spatiotemporal demography of a house sparrow metapopulation in a correlated environment. *Ecology* 83(2);561-569

Saether, B.E., Ringsby, T.H,, Bakke, Ö., and Solberg, E.J. 1999. Spatial and temporal variation in demography of a house sparrow metapopulation. *Journal of Animal Ecology* 68:628-637.

Skórka, P., Lenda, M. and Skórka. J. 2009. Supermarkets – A wintering habitat for House Sparrow *Passer domesticus* L. *Polish Journal of Ecology* 57:597-603.

Summers-Smith, J.D. 1959. The House Sparrow *Passer domesticus*: Population problems. *Ibis* 101: 449-455.

Summers-Smith, J.D. 1963. *The House Sparrow*. Collins, London.
Summers-Smith, J.D. 1988. *The Sparrows*. T. & A.D. Poyser, Carlton.
Summers-Smith, J.D. 1999. Current status of the House Sparrow in Britain. *British Wildlife* 10:381-386.
Summers-Smith, J.D. 2003. The decline of the House Sparrow: a review. *British Birds* 96:439-446.
Summers-Smith, J.D. 2005. Changes in the House Sparrow population in Britain. *International Studies on Sparrows* 30:23-37.
Shaw, L.M., Chamberlain, D. and Evans, M. 2008. The House Sparrow *Passer domesticus* in urban areas: reviewing a possible link between post-decline distribution and human socioeconomic status. *Journal of Ornithology* 149:293-299.
Tinbergen, L . 1946. De Sperwer als roofvijand van zangvogels. *Ardea* 34:1-213.
Wilkinson, N. 2006. Factors influencing the small-scale distribution of House Sparrows *Passer domesticus* in a suburban environment. *Bird Study* 53:39-46.
Williamson, K. 1945. Some new and scarce breeding species in the Faeroe Islands. *Ibis* 87: 550-558.

Appendix: House Sparrow population in different settlements in the Faroe Islands together with information on the infield sizes, demographic parameters as well as vegetation and separation of the villages.

Settlements	Pairs of House Sparrow	Area (km^2)	Perimeters (km)	Human population	Number of house holds	Number of houses	Amount of vegetation	Degree of Isolation
Fugloy								
Hattarvík	0	0.18	2.92	19	28	15	Poor	Isolated
Kirkja	0	0.22	3.46	22	37	29	Poor	Isolated
Svínoy								
Svínoy	25	1.04	6.21	61	76	30	Medium	Isolated
Viðoy								
Hvannasund	7	0.36	6.47	263	113	69	Poor	Isolated
Viðareiði	11	1.20	5.79	333	149	120	Poor	Isolated
Borðoy								
Ánir	0	0.08	3.32	14	34	6	Medium	Medium
Árnafjørður	0	0.18	3.49	60	44	23	Poor	Isolated
Depil	0	0.07	1.35	2	4	3	Poor	Isolated
Klaksvík	90	2.17	13.81	4590	2387	1500	Rich	Isolated
Múla	0	0.10	2.05	4	9	3	Poor	Isolated
Norðdepil	6	0.36	4.26	168	120	52	Poor	Isolated
Norðoyri	0	0.20	3.56	78	25	24	Poor	Medium
Norðtoftir	0	0.07	1.32	8	6	2	Poor	Isolated
Strond	0	0.04	1.29	0	22	5	Poor	Medium
Kunoy								
Haraldssund	0	0.11	2.57	74	46	20	Poor	Medium
Kunoy	10	0.30	3.63	65	37	25	Medium	Isolated
Kalsoy								
Húsar	5	0.27	3.89	48	32	20	Medium	Isolated
Mikladalur	12	0.47	4.22	54	57	40	Medium	Isolated
Syðradalur	0	0.10	1.37	13	21	12	Poor	Isolated
Trøllanes	0	0.26	2.41	23	11	5	Poor	Medium
Eysturoy								
Æðuvík	3	0.34	3.88	108	42	24	Rich	Medium
Eiði	38	1.45	8.04	653	313	224	Medium	Isolated
Elduvík	10	0.35	3.68	26	44	20	Rich	Isolated
Fuglafjørður	70	1.04	7.19	1538	726	522	Rich	Isolated
Funningsfjørður	5	0.18	3.34	77	51	20	Medium	Isolated
Funningur	2	0.30	0.32	85	71	50	Medium	Isolated
Gjógv	5	0.72	7.81	59	75	60	Medium	Isolated
Gøtugjógv	4	0.42	3.27	48	38	12	Medium	Medium
Hellur	0	0.16	2.12	31	28	18	Medium	Isolated
Innan Glyvur	4	0.17	1.85	77	94	24	Medium	Adjoining
Kambsdal	0	0.46	3.59	154	56	38	Medium	Medium
Kolbeinagjógv	0	0.04	1.20	34	15	11	Poor	Medium
Lamba	6	0.36	4.42	131	63	42	Medium	Medium
Lambareið	0	0.10	2.13	13	12	3	Medium	Adjoining
Leirvík	35	1.35	10.90	822	391	308	Medium	Isolated
Ljósáir	6	0.13	2.16	36	35	11	Medium	Medium
Morskranes	0	0.16	2.23	44	20	12	Medium	Medium

Settlements	Pairs of House Sparrow	Area (km^2)	Perimeters (km)	Human population	Number of house holds	Number of houses	Amount of vegetation	Degree of Isolation
Nes	0	0.34	3.91	225	91	71	Poor	Adjoining
Norðagøta	15	1.38	6.55	524	228	153	Medium	Medium
Norðskála	14	0.59	6.25	217	119	70	Medium	Adjoining
Oyndarfjørður	9	0.55	6.18	163	114	80	Rich	Medium
Oyrabakki	13	0.59	5.15	224	86	70	Medium	Adjoining
Rituvík	10	0.85	7.92	259	117	78	Medium	Medium
Runavík	110	1.42	10.10	1604	737	475	Rich	Adjoining
Saltnes	11	0.30	3.73	157	60	45	Medium	Adjoining
Selatrað	19	0.40	3.64	70	58	24	Rich	Isolated
Skála	43	1.28	8.83	588	319	207	Rich	Adjoining
Skálabotn	4	0.25	2.99	84	49	25	Medium	Medium
Skipanes	7	0.12	2.23	55	44	20	Medium	Adjoining
Søldarfjørður	20	1.00	8.67	337	146	101	Rich	Medium
Strendur	40	1.12	9.90	801	368	264	Medium	Adjoining
Svínáir	2	0.17	2.01	25	31	20	Medium	Medium
Syðragøta	13	0.97	5.64	388	190	132	Medium	Medium
Toftir	33	0.55	4.98	793	340	274	Medium	Adjoining
Streymoy								
Áir	0	0.01	0.52	0	4	11	Poor	Medium
Argir	70	0.99	8.63	1716	732	518	Medium	Adjoining
Haldórsvík	9	0.37	12.92	167	105	65	Medium	Isolated
Hósvík	18	0.40	3.30	260	122	86	Rich	Medium
Hvalvík	23	0.46	4.39	199	130	65	Rich	Adjoining
Hvítanes	11	0.27	4.11	102	38	29	Medium	Adjoining
Kaldbak	32	0.35	3.02	210	97	108	Rich	Isolated
Kaldbaksbotnur	0	0.16	1.80	7	13	3	Poor	Medium
Kirkjubø	5	0.20	2.42	79	36	21	Rich	Medium
Kollafjørður	73	1.06	13.81	780	386	558	Rich	Medium
Kvívík	28	0.48	3.67	372	174	98	Rich	Isolated
Langasandur	5	0.14	3.05	30	21	14	Medium	Medium
Leynar	3	0.26	2.67	90	79	45	Medium	Medium
Nesvík	0	0.06	1.57	1	21	1	Medium	Medium
Norðradalur	0	0.12	1.59	7	12	18	Poor	Isolated
Oyrareingir	0	0.36	3.21	40	29	14	Poor	Adjoining
Saksun	0	0.13	2.10	32	29	16	Medium	Isolated
Signabøur	5	0.24	4.51	100	61	145	Medium	Medium
Skælingur	0	0.13	1.55	14	11	5	Poor	Medium
Streymnes	13	0.53	5.19	161	76	55	Medium	Adjoining
Stykkið	2	0.14	1.82	44	35	19	Medium	Medium
Sund	0	0.06	1.05	3	17	1	Medium	Medium
Syðradalur	3	0.10	1.37	7	4	2	Poor	Isolated
Tjørnuvík	0	0.14	1.60	61	42	27	Poor	Isolated
Tórshavn	808	8.72	28.34	14957	7374	5220	Medium	Adjoining
Válur	0	0.02	0.62	48	38	17	Medium	Adjoining
Velbastaður	15	0.41	4.54	145	77	45	Medium	Medium
Vestmanna	63	1.30	9.55	1248	761	440	Rich	Isolated
Vágoy								
Bøur	7	0.12	2.39	62	38	23	Medium	Medium
Gásadalur	0	0.19	1.81	16	21	10	Poor	Isolated

Settlements	Pairs of House Sparrow	Area (km^2)	Perimeters (km)	Human population	Number of house holds	Number of houses	Amount of vegetation	Degree of Isolation
Miðvágur	60	2.89	12.78	959	494	391	Rich	Adjoining
Sandavágur	35	2.67	17.46	688	368	350	Medium	Adjoining
Sørvágur	45	2.43	12.79	939	552	340	Medium	Isolated
Vatnsoyrar	9	0.20	2.15	43	29	15	Medium	Medium
Mykines								
Mykines	0	0.27	1.94	21	51	32	Poor	Isolated
Koltur								
Koltur	0	0.13	2.53	2	2	2	Poor	Isolated
Hestur								
Hestur	0	0.57	7.24	50	42	24	Poor	Isolated
Nólsoy								
Nólsoy	40	0.51	3.01	264	179	100	Medium	Isolated
Sandoy								
Dalur	13	0.24	2.41	48	36	25	Rich	Isolated
Djúpidalur	0	0.06	1.29	7	1	1	Poor	Medium
Húsavík	3	0.69	4.84	89	65	49	Medium	Medium
Sandur	29	1.42	10.23	588	332	175	Rich	Medium
Skálavík	50	0.66	4.76	194	139	80	Rich	Isolated
Skarvanes	0	0.17	4.12	0	10	7	Poor	Medium
Skopun	27	1.63	14.79	480	250	261	Rich	Medium
Søltuvík	0	0.05	1.06	0	1	1	Poor	Medium
Trøðin	11	0.92	7.90	80	43	45	Medium	Adjoining
Skúvoy								
Skúvoy	15	0.53	3.71	75	55	40	Medium	Isolated
S. Dímun								
Dímun	0	0.11	1.60	7	1	1	Poor	Isolated
Suðuroy								
Akrar	5	0.05	1.19	28	22	12	Poor	Isolated
Fámjin	12	0.72	5.50	113	80	49	Poor	Medium
Froðba	15	0.37	3.47	155	123	101	Medium	Adjoining
Hov	35	0.86	8.13	122	187	39	Medium	Medium
Hvalba	30	1.20	9.89	647	357	210	Medium	Adjoining
Lopra	7	0.22	3.14	121	66	35	Poor	Medium
Nes (Hvalba)	10	0.25	3.59	120	49	42	Medium	Adjoining
Nes (Vágur)	0	0.06	0.98	32	9	13	Poor	Medium
Øravík	23	0.44	3.45	38	38	27	Poor	Medium
Porkeri	50	0.98	6.25	364	217	118	Medium	Medium
Sandvík	7	0.45	4.47	117	68	42	Medium	Medium
Sumba	20	0.85	5.63	282	153	111	Medium	Isolated
Tvøroyri	125	4.65	21.26	1184	751	363	Medium	Adjoining
Vágur	130	1.65	11.37	1395	923	537	Rich	Medium
Víkarbyrgi	0	0.07	1.56	2	9	3	Poor	Medium