Dispersal of young barn owls *Tyto alba* in Europe – a review[1]

by Ernst Kniprath

1 Introduction

This review in a way has been forced by the experience that different authors reproduce and interpret the statements of their predecessors quite differently. In a first part the steps to our knowledge are presented in their chronological order. Thereby the statement concerning the dismigration speed will be presented very summarily because the groupings of the distance values made by the authors are to different. Onto that "close recoveries" are defined very differently and mostly excluded. In the second part the presentation bases on the biology of the owls. Who is less interested in history could directly read that part and thus would be informed about today's knowledge. Therein we also try to clarify the boundaries between the commonly accepted themes and those with controversial opinions.

2 The chronology of the papers

About 30 years after the start of bird-ringing in Germany a first paper has been published which predominantly dealt with the recoveries of ringed barn owls (SCHNEIDER 1937). For this purpose the author could study the 419 recoveries collected by the two schemes "Vogelwarte Helgoland" and "Vogelwarte Rossiten". The results of this study are a solid basis for all further ones. A longer citation out of this work shall serve as introduction to make evident the status of knowledge of that time (translated).

"It [the barn owl] until more recent times was considered to be an exclusive sedentary bird, of which already NAUMANN wrote in his 'Natural History of the Birds of Central Europe' it would not change it's residence, and those which in later autumn ore earlier spring appear at places, where they usually do not breed, mostly would be young birds which, as it seems, roam about more than older ones. This opinion of the nearly entire philopatry of the barn owl among others is held by O. HEINROTH in tom 2 of his ‚Die Vögel Mitteleuropas'. Indeed, far leading movements of barn owls had not been documented until a short time ago, and still in 1931 in the Bird Migration Atlas besides six cases of recoveries over 50 km only one case of a greater movement of about 300 km is mentioned. In those days J THIENEMANN still mentioned concerning a ring owl which in 1923 had displaced from Liebertwolkwitz to Muschwitz near Halle (25 km westward from the ringing place) that it was the first proven case of a farer movement. As the trips of owls mostly happen during darkness they in general will remain hidden even to the best observers if not a lucky chance or banding helps. One example of a movement during daytime could be observed in the region of Henkenhagen near Kolberg 8 km apart from the shore on 23. X. 1932, where a barn owl flying in direction WSW very low only 2 m above the Baltic unobjectionably had been observed as migrating (GEORG RÖSSLER after comm. of 22.I. 33). In general displacements of barn owls are nothing new. So in the „New NAUMANN" RIESENTHAL mentions the fact being valid still today that on the Curonian Spit, where the barn owl is lacking as breeder, during later autumn repeatedly single or even smaller troupes of barn owls hag been met with, which 'apparently had been occupied with the certainly not to far leading trip to milder latitude'. In 'Die Vogelwarte Helgoland' HEINRICH GAETKE too for Heligoland

[1] Translation of: KNIPRATH E 2010: Die Wanderungen der jungen Schleiereulen Tyto alba in Europa, eine Literaturübersicht. Eulen-Rundblick 60:

mentions the irregular and sporadic passage of barn owls and accentuates the appearance of 10-11 specimen in the year 1876."
From the ring recoveries SCHNEIDER deduces a series of important conclusions:

- In the adults philopatry is predominant. Larger moving distances in this age group could be the results of false age determinations. For the breeding birds ringed by the author himself he could prove 4 km as a maximum distance.
- Yet days after their first flights young owls come back to their nests. After leaving the breeding site they displace into the nearer surroundings ore also to farer regions. Distances up to 745 km (and one from Hungary of 900 km) are documented.
- Young owls move to all directions independently of the season and of local factors. Siblings may dismigrate into totally different directions.
- There is no proof that a young owl would have come back to the birth place. Thus it seems more than questionable that we deal with "a form of migration in the usual sense".
- The dislocation of the young birds obviously means the search for a settling location seeming to them as appropriate.
- The wandering away is not caused by lack of prey. Even in very good years (such with second broods, which only do exist if prey are plentiful) this moving away takes place.
- Wanderings of barn owls may be invasion like but do not take place in all years in the same manner.

Already two years later P SCHIFFERLI (1939) confirms some of these statements. Also Barn owls in Switzerland displace into all directions when having become independent. Thereby mountains (Alps, Jurassic) act as barriers but in rare cases may be overcome (one owls flew to Italy). Here to a return to the birth place not has been stated.
After the study of the meanwhile increased material A SCHIFFERLI (1949) joins this opinion. "Displacements […] may be extensive, especially in winter seasons with a preceding numerous offspring". A new distance record is communicated (1080 km).
BAEGE (1955) adds two more distance records (of siblings!): 1270 km to the Ukraine and 1330 km to Spain. The author explicitly writes of "migration".
For years with extraordinary large wandering distances SAUTER (1955) introduces The term „Wanderwinter". As being such winters for south German barn owls she lists those of 1937/38, 1947/48, and 1952/53. For those predominant wandering events she names lack of prey as the seemingly essential cause. The irregular spreading of siblings is documented with nearly 100 cases. The general disorderliness of the dismigration is accentuated but pointed to a certain condensation in the northern direction and – in recoveries of > 300 km – of the western one. SAUTER underlines the "obvious repelling effect of the Jurassic and the Black Forest", hence of two higher mountain ranges of medium altitude.
The philopatry of the adult birds is corroborated with two recoveries with a medium distance of 7,3 km.
Also SAUTER (1956a) reports as new maxima of the recovery distance 1260 km and 1390 km. The author here refers to the birds ringed by BAEGE (1955).
Then, already in the same year, the exemplary study of the 809 ring recoveries of all German ringing schemes by SAUTER (1956b) appears. As this study of the wandering movements predominantly is governed by the question whether barn owl migrate, the smaller recovery distanced only occupy a minor space. SAUTER herself indeed writes (p. 145): the impression might have arisen that far distance wandering […] plays a great

role. This indeed by no means is the case [so] 44% belong to the 25 km, 63% to the 50 km zone!"
To the already mentioned "Wanderwinter" which she now names "Wanderjahre" the author adds 1928/29 and 1934/35. She assumes that the winters 1937/38, 1947/48, and 1952/53 also are Wanderjahre for the adult barn owls, but indeed she has a critical sight of the statement power of the recoveries. SAUTER defines Wanderjahre like this (p. 132): "We speak of Wanderjahre, if a particularly high percentage of young birds (about 5 to 6 fold as much as usual) cover distances of more than 100 km.
SAUTER (1956b p. 134) summarizes her knowledge concerning Wanderjahre like this:
"1. Wanderjahre concern primarily the yearlings, but several years old birds are not excluded.
2. The special wandering period is in autumn and should be finished about mid November.
3. A connection with weather events (so like strength of the winter) a priori has to be excluded (early start and mild winter 1947/48!).
4. The already earlier discussed connection to gradations of mice and voles resp. to the malnutrition caused is obvious.
5. Years with low vole populations however not always are Wanderjahre.
6. Years with high increase [of the owl population] not in every case cause wandering.
7. Both factors must coincide, i.e. the populations of barn owls must be filled up and the vole populations synchronously must go down. As this doesn't repeat rarely ever in the same numeric relations and so in one case provokes stronger and in the other case weaker consequences, the extents of the individual Wanderjahre are so different."
The description of the dispersal direction occupies a larger space. SAUTER insists that the directions indeed may be different depending on the region of ringing. So recoveries of the owls of the northern German lowlands do have "a clear concentration with respect to distant as well to nearer recoveries in the sector SW to NW." (p. 135) "In contrast those of Württemberg with respect to distances up to 200 km nearly homogeneously cover the vast segment W over N to E(SE); The farer recoveries too are distributed more evenly." In addition the "somehow repelling" influence of Jurassic, Black Forest, and Alps is considered. The belonging figure (p. 137) impressively proves that, especially if the detail figure the surrounding higher mountainous parts are inserted. These then astonishingly exactly fill the recovery gaps. Vice versa this means that these mountains don't give recoveries, which predominantly can be explained by the assumption that wandering barn owls avoid them.
SAUTER then stated a discrepancy in the dismigration behaviour between geomorphologically different areas even in a fairly narrow region (p. 135): In the Saxon barn owls "the young from breeding places in the lowlands predominantly dismigrate direction W […] so they stay in the lowlands and avoid the mountainous regions […] In contrast the young birds from higher breeding places distribute radiate in all directions. In the southern direction the "Erzgebirge" indeed mostly is avoided."
Onto this barrier function of mountains SAUTER states a similar one of larger waters. As Examples she names the British Isles and those of Denmark, the ring bird of whom rarely leave these isles. In addition here on the shores – as well as on the entire coast from Denmark down to the Gironde (France) – there is a concentration ov recoveries. (p. 138) "There in conformation to the geographic facts the moving should stop."
More than a decennium later FRYLESTAM (1972) confirms for southern Sweden and Denmark the undirected dismigration of the young owls but accentuates the blocking effect of mountainous regions. Here he especially points to the ridge Linderödsåsen, which separates southern Scone from the rest of Sweden. Northeast of it there are noch

recoveries of barn owls. The author also writes the birds probably had not the endurance necessary for a longer flight over sea. Nevertheless several owls from Sweden reached different Danish Isles and even Bornholm and Rügen. One bird ringed near Koebenhavn in Denmark was controlled in Scone and finally found dead in Mecklenburg (Germany). Also young owls ringed in Denmark starting from the isles by all means reached neighbouring isles and also the Continent.
For the GDR of that time SCHÖNFELD (1974 p. 102) accentuates "In years of low peaks of vole gradation the Dismigration is fast and far-reaching." For recovery distances >15 km he discovered the sector NW to SW as the direction clearly preferred.
Following KAUS (1977) the eastern mountains Thüringer Wald, Fichtelgebirge, and Oberpfälzerwald (county Bavaria, Germany) prevent Franconian barn owls from dispersing in this direction. Already the Franconian Jurassic hinders recoveries in the Oberpfalz east of it. For the Dismigration direction southeast obviously the Altmühl valley in the transition between the Fränkische and the Schwäbische Jura Mountains are used. Towards west seemingly there is no such restriction so that "the mass" of recoveries originates from here. Also following KAUS (1977) "at the final points of the wandering quite as a rule it comes to settlement and brood." Also in Franconia there were extent wandering but neither 1967 nor 1972 in connection with the collapse of the vole gradation. Preferably here the very high owl density is accepted as reason.
GLUTZ (1979) declares for the barn owls in Switzerland: The dismigration may start very soon after fledging. As a rule it begins in September and mostly has finished mid November. The young birds originating from early broods give themselves more time and wander further than the young of later broods. The statements of the two SCHIFFERLI (P SCHIFFERLI 1939, A SCHIFFERLI 1949) that the dismigration generally is undirected is confirmed. The hindering influence of as well the Alps as of the Jurassic is accentuated. GLUTZ writes very distinct "that the wandering ot the young barn owls is pure dismigration, i.e. endogenously ("dispersal") or exogenously ("spacing") caused active moving which leads to an alteration of the distribution of individuals in space".
In his study on the recoveries of the barn owls ringed in the GDR of that time KNEIS (1981) for the first time indicates that for some questions it is crucial to discriminate intentional records (= records made by ringers) against hazardous ones. As important themes of the phenomenon dismigration he names spreading and gene flow. Then KNEIS deals with the temporal and the special characteristics of this wandering. After him the dismigration mostly happens from September to November. Nevertheless already in August/September there are first greater dismigration distances. In the closer area spreading over the area is rather irregular. In the greater distances a preference of western direction becomes obvious but northern directions as well protrude a little. KNEIS considers a "possibly terrain mediated concentration". This ability to disperse over medium and greater distances would enable the barn owl to refill regional populations which had been diminished by exogenous factors.
In his material KNEIS (1981) recognizes two important influences on the wandering distances: birth date of the owls and vole density. Owls born earlier in the year will be found nearer to their birth place in the first year than those born later. The identical difference is valid for the settling distances illustrated by later recoveries. The density of voles acts likewise: scarcity forces farer Dismigration as well as settling. The important fundamental discussion of KNEIS concerning the character of Dismigration will be delt with later.
BUNN et al. (1982) point to the fact that British barn owls do not undertake far moving as had been described for the Continent. These authors for the first time extensively concern with how it happens in the life of the young owls that they disperse. First,

already fledged, they totally were fixed to the nest surroundings as guarantee for nutrition and safety. Then, starting at about day 66 of their life, they explore the farer surrounding and begin resting apart during the day. So they gradually “drift” away. Eventually the parents could give some pressure to the youngest. This possibility is considered only very cautiously.

The next study (after SAUTER 1956) of the now naturally substantially augmented recovery-material of barn owls ringed in southern Germany was done in 1985 by BAIRLEIN. Compared to earlier studies we here find that not the entire material was studied as an entity, but that it was subdivided following six geographic ringing centres. Between these partly significant differences were detected in the criteria tested: Time of dispersion, recovery distance, and direction, each of these solely as well as in their interactions. Concerning the direction of recoveries >100 km – despite all other differences – SW always belonged to those preferred. Reasons for the differences found „primarily should climatic factors which generally act by the availability of prey” (p. 97). The dispersal directions would be “at best influenced by the topography”. Entirely new is the statement that the recovery distances in later years of life exceed those in the first year. The owls thus might have wandered still farer away from their birth place after their first brood (breeding period). This holds true for all subdivisions studied.

In an extensive study GIRAUDOUX (1985) also evaluated the 1197 ring recoveries of French barn owls (which at 85% had been ringed in the more continental part of France, what means Burgundy and farer east). He also stated that the species only most rarely traverse larger waters and mountains. Onto that the distances passed clearly vary between the years. The author stated a significant correlation between the age of ringing and the distances passed. Here too the young from earlier broods pass greater distances than those from later ones. The distance record narrows 1275 km. No climatic factor was found for the inter annual oscillations of the recovery distances.

For Burgundy (France) BAUDVIN (1986) indeed found a slight preference of the direction W to S but no significance. He explains this wandering direction as due to barriers (mountains) and to the preference of the Rhone valley.

CHANSON et al. (1988) studied the dispersion of young barn owls in the Franche-Comté (East-France). Here there is no significant preference of any direction, though the Vosges extending north-easterly don’t give any recoveries.

For barn owls ringed in the Main-Kinzig-district (county Hessen, Germany) JAHNEL (1989) states that 80,6% had been recovered within 50 km. One recovery in the then CCCP (today Russia) at 47° 43’ N; 39° 50’ E, i.e. at the most south-eastern border of the distribution of the species in Europe, pushed the maximum recovery distance up to 2272 km. That means that young barn owls also wander towards the distribution borders and perhaps indeed cross them. There preferred direction of dispersal was NW, i.e. towards the Wetterau (landscape). Direction SE, i.e. towards the Spessart (mountains) rather was avoided.

ZANG et al. (1994) especially enter into the influence of higher wooded mountains on dispersing barn owls: In the “shadow” of the Harz Mountains recoveries from ringings north of it totally are lacking.

For Upper-Bavarian barn owls SIEGNER (1994) finds a main dispersal direction of N-NE.

The majority of British barn owls leave the birth place soon after fledging (TAYLOR 1994). There is no preferred direction. Most of the owls have finished their phase of dispersion after about three weeks and the majority settles within about 10 km. Only a few reach more than 50 km. The dispersion distance is not depending on the vole population. In the Scottish study area of TAYLOR (1994) the distance from the birth place to the later breeding site only for one bird of 83 exceeded 20 km. For 83% this distance

was less than 10 km. In this respect the difference between the sexes was significant: ♂ mostly settled within 5 km, ♀ of 6-10 km. These short distances in a certain extend also could have been the result of the density of breeding sites (boxes). As a measure more appropriate to the owl biology (better than to give kilometres) TAYLOR (p. 200) uses like already before him KNEIS (1981) a fictive diameter of the home range. In both sexes 90% of the birds settled inside the surprisingly short distance of about three of these home ranges. Taylor then discusses the function of dispersion as inbreeding barrier.
Spanish barn owls (MÁRTINEZ & LÓPEZ 1995) don't show the difference between those ringed earlier and those ringed later in the year concerning recovery distance. 81% of those being ringed as nestlings were recovered within 50 km. None of the owls was found farer away than 50 km in an age of more than one year. The authors deduce from that that a farer dispersion leads to death already during the first year of life. A preferred dispersion direction was not found. All these conclusions are based on 27 recoveries. Dispersion crossing the Pyrenees (the only possible direction by land) was not proved. In the opposite there indeed is a greater number of immigrants, which obviously didn't fear to cross the Pyrenees.
Barely 70% of the barn owls ringed as nestlings in the Netherlands were recovered within a radius of 50 km in all directions (DE JONG 1995). In those found farer the sector SW to NNE is not occupied as well (North Sea and Channel). Only three owls reached England, hence travelled over sea (supposing that they didn't travel by ship). Among the far-recoveries there is a gap in south-eastern direction. One owl has bred at her proper birth place.
In his thesis HILLERS (1998) has studied the recoveries of barn owls ringed in the county Schleswig-Holstein (Germany). Also here becomes visible that the dispersion of the owls ringed as nestling preferably takes place up to October/November. In his material the author sees indications that with end of their first winter the owls again move away from their birth place. Owls which had been ringed earlier in the year were found rather closer to their birth place than those which has been ringed during June/July. Altogether 70% had been recovered within a radius of 50 km. The owls recovered within 100 km didn't show any preferred direction in their wandering. In the greater distances SW dominates. In the directions W and N the North-Sea delimits the dispersion, In the direction NE on one hand it is the Baltic Sea, on the other hand in this direction the distribution limit of the species is near. An explanation for the obvious under-representation of S is lacking. For the first time here is documented that the age reached up to the recovery is dependant on the dismigration direction. There is as well a connection between recovery-direction and recovery-month.
Again the recovery of an owl, ringed as Nestling in Northern Württemberg (Germany), in Russia (58.09 N; 30.17 E) showed that dispersing barn owls do not leave the direction towards the distribution limit (GRAEF 1998).
Following SHAWYER (1998) English young owls on average were recovered at about 9 km. Nevertheless birds in sparsely inhabited areas dispersed farer. The actually reached mean distances even could be smaller, for recoveries of living birds of <5 km were not registered.
MÖNIG & REGULSKI (1999) studied the small population of the northern "Bergisches Land" (county Nordrhein-Westfahlen, Germany). 33 of the owls ringed as nestlings were recovered in direction SSW-N. The authors explain the far-reaching lack of notifications from other directions with topographic peculiarities in these directions (this refers to wooded mountains) (WUNTKE & LUDWIG 2000).
In the Easter German counties Brandenburg and Mecklenburg-Vorpommern (MVP) the dispersing young owls in their direction-selection show a significant difference only

therein that those from MVP omit the direction N. The Baltic-Sea is not crossed. Altogether in these two counties slightly more wander in direction W than E.
Barn owls ringed in Hungary (MÁTICS & HORVÁTH 2000) don't travel any more considerable distances after the dispersion during their first year. For the study of the dispersion direction of the young owls it showed necessary to separate the data from the district of Tolna (which gave more than 50% of the total material) from the resting ones. The former ones preferred a northern direction (not significant), the remaining ones a easterly one (significant). For the authors this direction E might be caused by the barrier effect of the Alps. The remaining mountains surrounding Hungary are not mentioned.
For the same population MÁTICS (2003) did find no significant preferred direction of the dispersion. (Here – differing from the former paper – the data of the district Tolna were not studied separately.) In the conversion he indeed found that owls ringed outside Hungary and recovered in Hungary preferably came from W-N. MÁTICS discusses the extent of gene flow between sub-populations by the juvenile dispersion.
For the barn owls ringed as nestlings in the district "Hohenlohekreis" (county Baden-Württemberg, Germany) there was no preferred direction of dispersion in the lower dispersion distances, but for the higher ones a preference of the directions W and WSW, in a smaller extent also N (influence of the Alps) (GRAEF 2004).
The far-distance-wanderers among the young owls in Luxembourg preferred SW, a few also N (HEIDT 2006).
SÁROSSY (2007): From Slovakia an owl flew to Barysch (53,41 N; 47,04 E; Russia), hence far beyond the limits of the species.
In a separate chapter POPRACH (2009) studies the dispersion of the barn owl in the Czech Republic and in Slovakia. Concerning dispersion direction he doesn't find any preference. On owl from the Czech Republic was recovered near Peremyshl (54,17 N; 36,07 E, Kaluga, Russia), hence fairly east of the known range of the species.

3 Description by content

From the observations of moving Owls already before the first ringing results it had been known that barn owls do not stay all their lifetime at the same place (see above SCHNEIDER 1937). However only ringing could clarify that the adult birds mostly are sedentary and only the young barn owls after being independent emigrate in a lesser or greater extent from the home range of their parents (SCHNEIDER 1937 and all later authors). Here we depict this dispersion in its known phases and peculiarities and then enter into the cause(s) and biological functions of this phenomenon.
For most of the young owls dispersion ends by death. Nevertheless also those who survive, will not wander indefinitely. In their studies not all authors discriminate between these two situations. In the following we explicitly point at if this discrimination was made. When owls are found dead this recovery at least means that up to their death they had reached the recovery site but not, whether dispersion already before had or in the case of survival would have ended here. As a consequence only those recovery data of owls ringed as nestlings should be used, which had survived the first winter. For these we could guess that they had reached a site which seemed to them appropriate for settling or where they already had settled. Such a discrimination also would avoid those difficulties arising by the fact that young owls found near to their birth places often not have been recorded.

The course of the dispersal

Young owls just for days after their first excursions come back to the nest site. After leaving the nesting place they disperse into the nearer surroundings or even to farer places (SCHNEIDER 1937). BUNN et al. (1982: 149) gave about this depiction: At first – already fledged – they were totally fixed to the surroundings of the nest as guarantee for food and safety. Then, beginning about day 66 of their life, they explore the farer surrounding and begin to pass the daytime also offside. So they gradually 'drift' away. This gradual drifting-away has been studies by FRANKE (1995) for three young birds by telemetry. All three (from two broods) for the first time leaved the breeding building resp. the nest box in an age of about 60 days. Nr. 1 lost its transmitter already during the first flight-night. The two others used the nest box during the first two days and never later on. Then they passed the days in different buildings and also in dens trees of an avenue and a cemetery in the direct vicinity. Already during the third flight-night the action-diameter was enlarged up to 300 m, and in the fifth up to 600-700 m. Already during this time the siblings made use of several and also different hunting areas. Nr. 3 thereby a little more used the farer areas. Both were still found in the study area during night Nr. 16.

Following SCHNEIDER (1937) the movements "do not pass all years in the same manner", they "may be invasion-like". These very intensive dismigration events later will be discussed separately. Here follows the discussion of the "normal" spreading.

Interval of movements

For SAUTER (1956b) the wandering take place during autumn and "should be finished about mid November". After GLUTZ (1979) the dispersal normally begins mid September and is mostly terminated mid November. Here we first meet with the knowledge that birds from earlier broods "give themselves more time" than the young from later broods. Also after KNEIS (1981) and HILLERS (1998) this dismigration mainly occurs from September to November. But already in August/September there are the first great dispersal distances. For the time of wandering BAIRLEIN (1985) finds differences between the sub-areas in Southern Germany.

For young owl in England the dispersal already has ended after about three weeks (TAYLOR 1994).

Differing from all other authors HILLERS (1998) for Schleswig-Holstein (Germany) finds that the owls at about the end of their first winter (January-March) again move farer away from their birth-place, and BAIRLEIN (1985) for South Germany that the recovery distances of later years surpass those of the first year. The owls thus should have moved farer away from the birth place after their first brood (breeding period). This is valid for all sub-areas studied by BAIRLEIN. MÁTICS & HORVÁTH (2000) accentuate that the Hungarian birds don't add significant distances to their juvenile movements.

There is no explication for the newly wandering after their first breeding period stated by BAIRLEIN (1985) and HILLERS (1998). At one hand it seems astonishing that none of the former authors has recognized similar phenomena and. But also - on the other hand – none of the later authors enters into this phenomenon.

Here we massively meet with the problem of the real content of dead recoveries. Barn owls in their survival strongly depend on prey present, on the reachability of it, and all that especially during adverse weather. All three influences indeed may differ spacially and temporally. If those negative circumstances happen at larger distances from the ringing site then the numbers of recoveries in that regions increase and depending likewise the mean values of the recovery distances counted. This might simulate a new wandering movement. The reverse as well is possible: The circumstances nearer to the place of ringing get worse evidently compared to the farer distances. Then the owls seem to have moved again closer to their birth place.

Direction of wandering

Beginning with SCHNEIDER (1937) all authors agree that the young owl drifting apart, thereby don't prefer a certain direction. Multiple recoveries of disperging owls analysed by SAUTER (1956b) onto that demonstrate that the owls not in any case keep the direction first chosen but obviously change it optionally and also not only once. This too may led to the fact that some young owls effectively do not come far, even in the most extreme case later breed at their proper birth place. This breeding in the birth place is described by DE JONG (1995). KNEIS (1981) too gives examples for a changing of direction.

The irregularity with respect to the directing of the dismigration also is underlined by the behaviour of siblings. These may disperse into exactly the same or into totally opposite directions (SAUTER 1956a, KNEIS 1981, FRYLESTAM 1972, POPRACH 2009).

This irregular wandering is continued as long until geomorphologic structures prevent that. Being such structure the following were described: great waters (SAUTER 1956b, FRYLESTAM 1972, HILLERS 1998, WUNTKE & LUDWIG 2000), higher mountains (P SCHIFFERLI 1939, A SCHIFFERLI 1949, SAUTER 1955, 1956b, FRYLESTAM 1972, KAUS 1977, GLUTZ 1979, GIRAUDOUX 1985, BAUDVIN 1986, CHANSON et al. 1988, JAHNEL 1989, ZANG et al. 1994, SIEGNER 1994, MÁTICS & HORVÁTH 2000, GRAEF 2004), or generally topographic structures (KNEIS 1981, Bairlein 1985, MÖNIG & REGULSKI 1999). These barriers indeed not enforcedly stop the dispersion. For example, great waters obviously also may be traversed as three owls ringed in the Netherlands and found in England prove (DE JONG 1995). Danish birds likewise fly from one isle to the next one and also to the mainland and Swedish young owl reach Denmark, Bornholm, and Rügen. A bird, ringed in the vicinity of Copenhagen in Denmark was controlled in Scone (Sweden) and finally found dead in Mecklenburg (Eastern Germany) (FRYLESTAM 1972). Here indeed we might consider that between the Danish isles themselves and also the mainland and also Sweden nearly always there is a narrow sound, whom to pass not might be to difficult. Of course in none of these cases it can totally excluded that the birds had used a ship-passage. With the greater-most probability a barn owl ringed in England and caught in a great storage hall in South-Lower-Saxony (Germany) in which the day before a lorry from England had been unloaded (KNIPRATH unpubl.) had used this lorry for her passage. Also birds found on the shore (of not ringed birds, HEIDT 1969 after GLUTZ & Bauer 1994: 248) or also the appearance of barn owls on the isle of Helgoland (GAETKE in SCHNEIDER 1937, see above) prove that occasionally the bird try to fly over the sea. In these cases it was always thought possible that the owls had totally or in part used a ship passage (GLUTZ & BAUER 1994). The barn owl doesn't belong to the Finnish breeding bird fauna. Finland might be reached by Swedish owls and also those from the Baltic States only by improbable distances over land or indeed over sea. The Finnish Committee (W VELMELA, Finnish Rarities Committee, 20.3.2007 in litt.) in two of the seven cases of barn owls found in Finland holds a ship passage for possible, in the others not.

Mountainous regions as well (GLUTZ & BAUER 1994) may be crossed. SCHIFFERLI (1949) names a Swiss bird, which emigrated to Italy. These mountainous regions also could have been flew around or passes could have been used as by the indeed numerous central European birds which reach Spain. Obviously the Pyrenees for barn owls are a much inferior barrier than the Alps as their north-south–extension is much less. Onto that at their eastern edge there is a fairly good as not to high passage. In addition it

seems possible that those owls which leave Central Europe in direction SW at the lower end of the Rhone-valley prefer to keep the general SW-direction than to swing into an eastern direction.
In spite of the depicted influences of topographic facts on the dispersion direction, in many authors we find indications that in continental Europe concerning the farer recovery distances there is the appearance of a certain tendency towards western directions (SAUTER 1956b, SCHÖNFELD 1974, KNEIS 1981, BAIRLEIN 1985, JAHNEL 1989, HILLERS 1989, MÖNIG & REGULSKI 1999, WUNTKE & LUDWIG 2000, GRAEF 2004, HEIDT 2006). This doesn't hold for English (TAYLOR 1994), Spanish (MÁRTINEZ & LÓPEZ 1995), and Hungarian MÁTICS (2003) barn owls and likewise not for those in the Franche Comté (France) (CHANSON et al. 1988). The owls in the Netherlands (DE JONG 1995), which cannot use the directions W to NNE on account of the sea and which rather omit the direction SE – obviously because this direction is mountainous – most likely can fly far distances if the use the direction SW. As reason for the slight, not significant preference of the direction W to S of owls from Burgundy (France) BAUDVIN (1986) assumes only the geomorphologic barriers in the other directions. Also in Switzerland the dispersion direction mostly is forced by the alignment of the Alps and the Jurassic (P SCHIFFERLI 1939, A SCHIFFERLI 1949, GLUTZ 1979).
What mainly remains to be explained is the W-SW direction or German barn owls. If there were a somehow inherited starting direction – similar to that valid here for migrating birds – than this should be visible already in the lower distances. For us it seems much more likely that the owls in these "preferred" directions find sufficiently favourable conditions to enable them to survive more often farer distances. We insist in "more often". Extremely great distances occasionally are reached as well in other directions (see below).

Dispersion distances

The measuring units used by the authors to characterize the distances reached indeed are so different that a comparison hardly is possible. Nevertheless it is certain tha English owls reach much lesser distances (BUNN et al. 1982, TAYLOR 1994, SHAWYER 1998) than those in continental Europe. The majority settles within about 10 km. Only a few reach more than 50 km. In the Scottish study area of TAYLORS (1994) the distance from the birth site to the later breeding place only for one of 83 birds was greater than 20 km. For 83% this distances was less than 10 km. For the first time in TAYLOR (1994) we find data to the difference between the sexes: ♂ mostly settled within 5 km, ♀ of 6-10 km. This difference is significant. These altogether low distances after TAYLOR to a certain extent also could be the consequence of a high density of breeding sites (boxes). SHAWYER (1998) comes to similar numbers. In his area indeed the birds from areas of lower owl densities wandered farer. The mean distances really reached could be still lower as recoveries of living birds of <5 km were not registered.
Fledglings from earlier broods travel farer than those of later ones (GLUTZ 1979). The same result is given by KNEIS (1981). This became visible on one hand in the recoveries from the first autumn in their lives and on the other hand from the settling distances after recoveries in later years. Also GIRAUDOUX (1985) und HILLERS (1998) found this difference between those ringed early and those ringed late. For the Spanish fledgkings such a difference doesn't exist (MÁRTINEZ & LÓPEZ 1995).
For the Spanish barn owls recoveries of >50 km only did exist during the first autumn and winter of their lives (MÁRTINEZ & LÓPEZ 1995). The authors deduce there from that dispersion over farer distances already during the first year of life leads to death.

Especially far movements an one hand are possible solely in direction SW, i.e. to Spain. Obviously Africa hitherto not has been reached by a single ringed barn owl from Europe. On the other hand an owl reached 2272 km in direction E (JAHNEL 1989), another one 1674 km direction NE (GRAEF 1998). Except in the region of the Bosporus each extreme far going movement in direction SE theoretically ends at a shore. The supposition of the authors that preference of a certain direction becomes visible not in the nearer zone but only at the greater distances suggestion the interpretation: Here we don't see a real preference but the expression of the probability in which direction far wandering at most is possible or/and perhaps also, where the recovery probability is greater.
How wandering barn owls behave when they approach the borderline of the species area, which is not given by the sea, in Europe only may become visible in Scandinavia and Eastern Europe. Indeed FRYLESTAM (1972) proves fledgelings from South-Sweden obviously don't fly over the ridge Linderödsåsen, which separates Southern Scone from the rest of the country. North-East of that ridge there are no barn owl recoveries. This ridge here indeed is the borderline of the barn owls breeding area. The seven specimen hitherto found in Finland (W VELMELA, Finnish Rarities Committee, 20.3.2007 in litt.) clearly demonstrate that they pas this borderline: The barn owl doesn't belong to the Finnish breeding bird fauna. For Swedish owls as well as for those from the Baltic States Finland might be reached only by unlikely distances over land or indeed over sea. The Finnish Committee estimates ship-assistance in two of the seven cases as possible, in the others not. For owls from Central Europe came into the vicinity of the known eastern border or far beyond it:

- From the Main-Kinzig-district (Hesse, Germany) to 47^{o} 43' N; 39^{o} 50' E, hence to the south-easternmost border in Europe (JAHNEL 1989).
- From the Hohenlohe-district (Baden-Württemberg, Germany) to 58,09 N; 30,17 E, hence to the north-eastern border area (GRAEF 1998).
- From the Czech Republic until Peremyshl (54,17 N; 36,07 E, Kaluga, Russia) (POPRACH 2009).
- From Slovakia to Barysch (53,41 N, 47,04 E, Russia) (SÁROSSY 2000).

As in the owls from the Netherlands, which – as mentioned above – reached England or the English one, which reached Germany, here also passage by vehicle cannot be excluded.
KNEIS (1981) as well as TAYLOR (1994) propose instead of the usually given measure for recoveries the use of the diameter of mean home-ranges. Thereby in the territory of the then GDR KNEIS uses 5 km, TAYLOR in Scotland 1 km.

Other dispersion criteria
A dependence of the age reached until recovery from the departure direction was found by HILLERS (1989). After him there is as well a connection between dispersal direction and finding month.

Wanderjahre
In 1937 SCHNEIDER wrote of occasional invasion-like movements and A SCHIFFERLI (1949) of extended wandering away after a preceding great offspring. SCHIFFERLI includes winters in which two third of the owls recovered had wandered more than 50 km. For that SAUTER 1955 uses the term "Wanderwinter", later (1956b) "Wanderjahr". For this latter term has been adopted by the international barn owl literature, we here still use it. SAUTER (1956b) defines: „We speak of Wanderjahre if a very high percentage

of fledgelings (about 5 to 6 fold as much as usually) travel over distances of more than 100 km".

Tabel 1: Chronological summary of the Wanderjahre after the authors

country/region	winter		author	year
D /	1928/29		SAUTER	1956b
D /	1934/35		SAUTER	1956b
Switzerland	1937/38		SCHIFFERLI	1949
D / South-Germany	1937/38		SAUTER	1955
Switzerland	1947/48		SCHIFFERLI	1949
D / South-Germany	1947/48		SAUTER	1955
D / South-Germany	1952/53		SAUTER	1955
D / Franconia	1967/68		KAUS	1977
D / Franconia	1972/73		KAUS	1977

SAUTER (1956b p. 134) summarizes her results concerning Wanderjahre like this:
"1. The Wanderjahre principally concern the yearlings but several years old birds are not excluded.
2. The special wandering period lies in the autumn and might be finished mid November.
3. A connection with meteorological events (such as strength of the winter) a priori has to be excluded (early erupt and mild winter 1947/48!).
4. The dependence on rodent gradations as discussed already earlier, respectively with the nutrition scarcities caused is obvious.
5. Rodent poor years indeed not always are Wanderjahre.
6. Years with stronger reproduction not in each case cause wanderings.
7. Both factors must coincide, i.e. the barn owl population must be filled up, the rodent populations decrease simultaneously. As this scarcely eve repeats in exactly the same numeric relations and so once makes follow stronger, once weaker results, the extends of the individual Wanderjahre are so different."
KAUS (1977) for Franconia states two Wanderjahre (1967/68, 1972/73), which had "no connection with a crash of the mouse population". He prefers as cause an extremely high owl density.
SAUTER (1956b) assumes that the winters 1937/38, 1947/48, and 1952/53 also for adult barn owls count as Wanderjahre, nevertheless critically estimates the real meaning of the recoveries.
GIRAUDOUX (1985) did not find any indication for a dependence of the high oscillations of the dismigration-distances between the years and climatic factors.

Causes and functions of dispersal
For the statement in GLUTZ (1979) and in the German handbook (GLUTZ & BAUER 1989), the fledglings should be expulsed from the home-range by their parents, we don't find, as already KNEIS (1981: 53) mentioned, at least in the authors cited for (SCHÖNFELD & GIRBIG 1975 and SCHÖNFELD et al. 1977) no indication; as to BUNN & WABERTON (1977) see below. KNEIS (1981: 53) nevertheless estimates an expulsion as probable. Also EPPLE (1993: 60) describes an expulsion of the young by the parents. In that case the observation exclusively was that the ♀ expulsed the fledged young from the nearer nest-surroundings if a second brood approached. Then the begging owlets were troublesome for the new courtship and copulae. EPPLE here cites BUNN & WABERTON

(1977), who described something similar. These two authors describe explicit that the young would be expulsed. In contrast BUNN et al. 1982 consider very cautiously the parents eventually could give some pressure on the younger pulli to disperse. We should keep that obviously there is no proof for the expulsion of the fledged young from the “territory”.

SCHNEIDER (1937) decisively repulses that the general dispersal should be caused by scarcity of prey with the argument it also would happen in extremely good years. For the then GDR SCHÖNFELD (1974 S. 102) emphasizes that “ in years of a low peak of the mouse gradation there is a very quick and spacious dismigration”. KNEIS (1981) writes the density of voles would act on the dispersal distances: Lack forces to wander and settle farer. (Here for the first time an author discriminates between the dispersal distances of the first autumn and those of the settling distances given by later recoveries.) This interpretation by KNEIS well could be an explanation for the farer wandering of fledglings from lesser colonized regions in England as described by SHAWYER (1998): A thinner colonization indicates a fairly scarce prey offer.

SCHNEIDER (1937) assumes: “When fledglings disperse they obviously are looking for a site seemingly appropriate for their settlement.” KAUS (1977) also is convinced that “at the end of the dispersal the generally settle and breed”.

GLUTZ (1979) very firmly writes “that the wanderings of young barn owls are a mere dismigration, i.e. spatial displacements caused endogenously (dispersal) or exogenously (spacing), which lead to a new spatial dispersion”.

Especially KNEIS (1981: 51 ff.) manifests with respect to the character of dismigration: “Related to a complex behavioural process, which the dismigration principally is, the question cannot be whether it is controlled (merely) endogenously <u>or</u> exogenously. It is more advantageous to use very formally terms borrowed from the cybernetic system-description” “ and instead of speaking of ‘spacing’ of forced and instead of ‘dispersal’ of free (= not forced) undirected wandering. Thus the essential question concerning site fidelity or site-change – does a part of the individuals wander on account of an internal stimulus or (solely) under ecological pressure such as competition, interference, opponence, or loss of habitat, respectively which relations between the two facts cause which individual reactions? – may be formulated more precisely.” “ The spatial alterations of barn owls ringed as nestlings, mainly falling into the autumn of the first calendar-year improve…..exclusively as undirected wanderings.”

As to the terms FRANKE (1995: 85) points to SEDLAG & WEINERT (1987), who say that dispersal is the process, which leads to dispersion (the pattern of distribution).

As functions of dispersal KNEIS (1981) sees “propagation and gene-flow”. The capacity of dismigrating over middle or greater distances enables barn owls to refill quickly populations thinned regionally by exterior influences. Gene-flow between the Hungarian population and those surrounding is also discussed by MÁTICS (2003). TAYLOR (1994: 199) guesses that dismigration also has a function as inbreeding barrier.