05.05 Balance Sheet of Breeding Bird Population (Edition 1995)

Overview

Breeding birds are for various reasons well-suited as **indicators for the evaluation of habitats**. They occur in almost all landscape types and settle them quickly, they display no extreme fluctuation of population, and, since they are at the end of the food chain, they make complex demands upon their respective habitats.

They are generally well-studied, since there are so many interested avifaunistic (ornithological) persons and groups; moreover, breeding birds are relatively easy to observe.

Indicators react in visible ways to ecological damage, and thus represent other groups of organisms, or whole biotic communities. Breeding birds can, as indicators, indicate deficits and qualities of habitats, such as near-naturalness, structural diversity, intensity of disturbance or the relationship to other habitats, (cf. Matthäus 1992) and thus form a basis for conservation planning. This is especially true of **indicator species** (*Leitarten)* in the present sense, i.e., those specialized toward particular habitats. According to investigations by Flade (1991, 1994) indicator species reach significantly higher frequency (abundance or sighting probability in the investigation areas, which are usually at least 10 ha in size), and usually also markedly higher settlement density (brood pairs per 10-ha investigation area) in only one, or in a very few, habitat types, than in all other habitat types. In their preferred landscape types, indicator species find their required habitat structures significantly more often and, most importantly, more regularly, than in all other landscape types. Ubiquitous species (garden-variety species) are of little significance by comparison, because of their slight degree of specialization. The goldcrest, as an example of an indicator species, shows high frequency and settlement density in only four habitats characterized by spruce (cf. Fig. 1). For the willow warbler, by contrast, as an example of a ubiquitous species, significantly preferred habitat types cannot be ascertained (cf. Fig. 2).
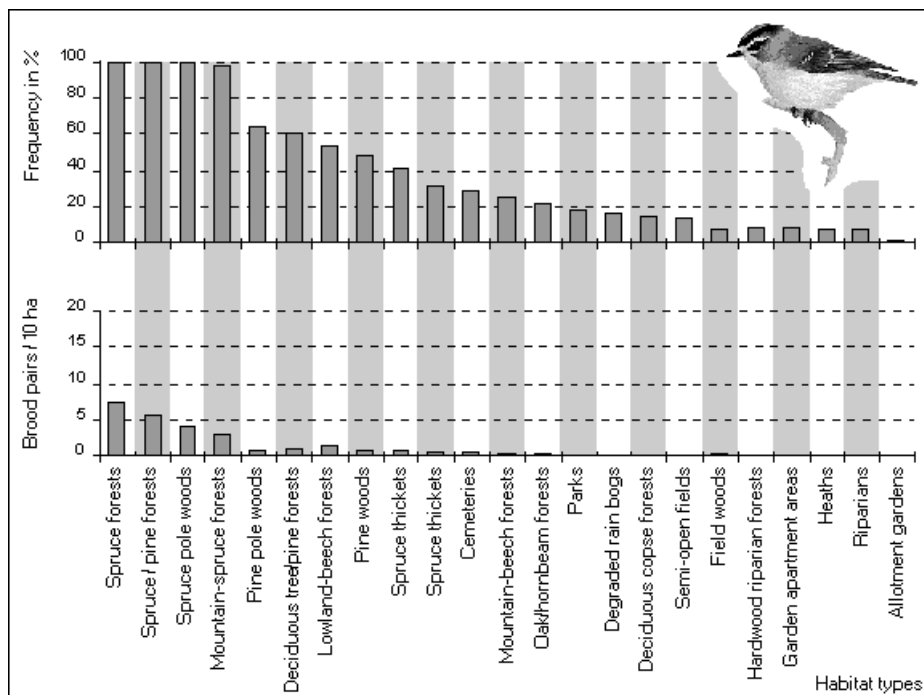

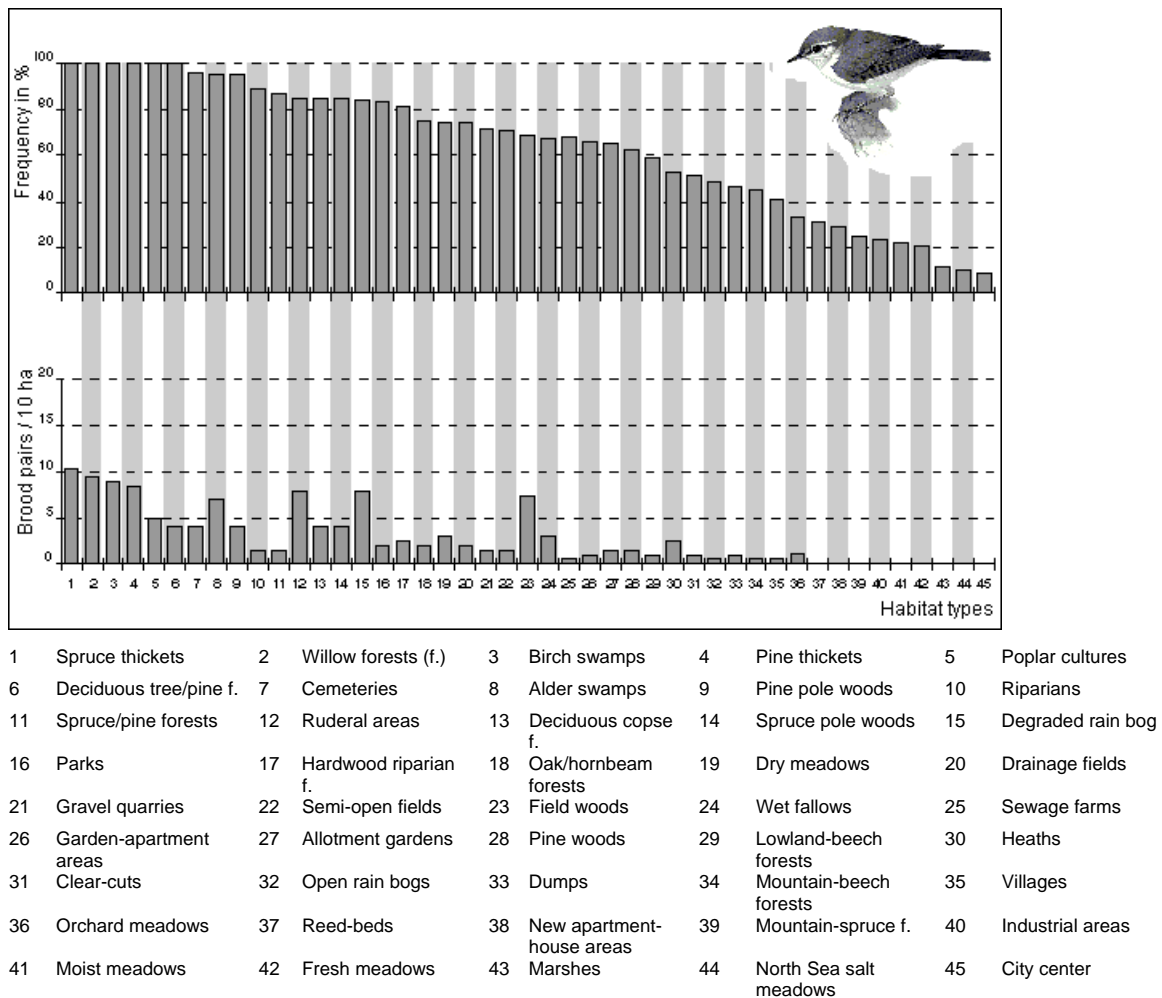*Fig. 1: Ecological Profile of an Indicator Species (Goldcrest - Regulus regulus) (Flade 1991)*

Fig. 2: Ecological Profile of a Ubiquitous Species (Willow Warbler - Phylloscopus trochilus) (Flade 1991)

1	Spruce thickets	2	Willow forests (f.)	3	Birch swamps	4	Pine thickets	5	Poplar cultures
6	Deciduous tree/pine f.	7	Cemeteries	8	Alder swamps	9	Pine pole woods	10	Riparians
11	Spruce/pine forests	12	Ruderal areas	13	Deciduous copse f.	14	Spruce pole woods	15	Degraded rain bog
16	Parks	17	Hardwood riparian f.	18	Oak/hornbeam forests	19	Dry meadows	20	Drainage fields
21	Gravel quarries	22	Semi-open fields	23	Field woods	24	Wet fallows	25	Sewage farms
26	Garden-apartment areas	27	Allotment gardens	28	Pine woods	29	Lowland-beech forests	30	Heaths
31	Clear-cuts	32	Open rain bogs	33	Dumps	34	Mountain-beech forests	35	Villages
36	Orchard meadows	37	Reed-beds	38	New apartment-house areas	39	Mountain-spruce f.	40	Industrial areas
41	Moist meadows	42	Fresh meadows	43	Marshes	44	North Sea salt meadows	45	City center

For the present map, a balance sheet of the breeding bird population was developed using the indicator species to be expected (ideal situation), and the indicator species mapped in the breeding-bird atlases of Berlin (actual situation). The indicator species to be expected were derived from habitat mapping, with the aid of the indicator species groups determined by Flade (1994) and transferred to the breeding-bird habitats available in Berlin.

As background information, a potential avifaunistic evaluation and also a survey of the occurrence of Red Data Book species were prepared for these areas. In this way, on one hand, the different value of the habitat types was shown, and on the other, the assignment of the occurrence or absence of indicator species was facilitated.

Thus, the present map elucidates the situation of deficit areas and makes possible an evaluation of the quality of different urban areas. It forms the basis for cause analyses and the implementation of targeted measures, i.e., in form of species relief programs, such as those provided under the Berlin Conservation Law. Species protection-related questions, e.g. the question of the stability of the populations found, or the species wealth of certain areas, were not the focus of the investigation.

Statistical Base

The **avifaunistic data** originated from the breeding-bird atlases of Berlin (East and West), the Red Data Book of breeding birds in Berlin, and the results of the investigation *"Die Brutvogelgemeinschaften Mittel- und Norddeutschlands. Grundlagen für den Gebrauch vogelkundlicher Daten in der Landschaftsplanung"* (The Breeding Bird Communities of Central and Northern Germany - Foundations for the Use of Ornithological Data in Landscape Planning) (Flade, 1994).

For both **atlases,** the breeding-bird occurrence in Berlin was mapped comprehensively by means of a grid of squares approx. 1 km^2. The survey was carried out in West Berlin between 1976 and 1983 on the basis of a grid based on geographical coordinates composed of half-minute lines of latitude and minute lines of longitude (cf. Ornithological Team of Berlin (West) 1985). In the eastern part of the city, a grid was used for which the ordnance survey maps were furnished with an 11 x 11 overlay of approximate squares (cf. Degen et al., 1988, and Magistrate of [East] Berlin, 1989). The breeding-bird mapping occurred between 1978 and 1982. Because no more current breeding bird map exists for Berlin or is planned at this time, it was necessary to make do with this database. Where no serious changes in the structure of the urban area have occurred in the interim, it can be assumed that the results are transferable to the present situation. For areas with major changes, no statements are made.

The 1991 Red Data Book of breeding birds in Berlin (Witt 1991) contains, in addition to an assignment of the species to the classes of the Red Data Book, a total list of all breeding-bird species with population estimates and tendencies for the whole city.

The work of Flade in 1994, with the aid of investigations from the period 1950 to 1989, provided, among other things, potential indicator species groups for the habitat types of Germany north of the crest of the Central Mountains, and developed methodological approaches for an avifaunistic evaluation of habitats.

For the **survey of habitat types,** it was necessary to use different bases for the two city halves. Uniform processing for the habitat type survey is valid as of 1992.

For **West Berlin**, an abundant statistical base was available. This included maps from the Species Protection Program of the 1984 Landscape Program (Care and Development Measures for Biotope Types, Biotope Development Areas), from the 1985-'87 Berlin Environmental Atlas (Ecological Condition of Shores and Banks, Urban-Ecological Area Units, Vegetation, Valuable Habitats for Flora and Fauna, Age and Inventory Structure of the Berlin Forests, Actual Use of Built-up Areas, Inventory of Green and Open Spaces), from the 1986 Landscape Program (Biotope and Species Protection), and from the Berlin Environmental Atlas as of 1992 (Valuable Habitats for Flora and Fauna, Open Space Development since 1950). These maps were updated and supplemented with the aid of aerial photography from the aerial operations in April 1989 and in August 1990.

The statistical base used for **East Berlin** includes maps from the Berlin Environmental Atlas as of 1992, (Sewage Farms, Actual Use of Built-up Areas, Inventory of Green and Open Spaces, Open Space Development Since 1950, Age and Inventory Structure of the Berlin Forests, Urban Structure) and the 1993 Landscape Program draft (Biotope Types, Value of Biotopes), as well as 1991 ecological expert opinions on the Gosen Meadows and the northeastern part of Seddin Lake, and on the Karow Ponds in the former Blankenfelde and Buch sewage farms. However, data on many areas had to be supplemented with material from the above-mentioned aerial photography operations.

Some areas of Berlin, such as West Staaken, were mapped with the aid of aerial photography operations and of locally knowledgeable people. Also, areas with extensive open space losses (around the newly-built freeway in the Tegel Forest or the new housing areas in Marzahn, Hellersdorf and Hohenschönhausen) or significant use changes since 1980 (such as the newly reafforested sewage farms at Buch) had to be excluded. For this purpose, maps from the Berlin Environmental Atlas (1992), (Sewage Farms, Open Space Development since 1950) were used.

Methodology

First of all, the breeding bird habitats were certified area-specifically according to the break-down of Flade (1994). By means of an addition of all habitats occurring in a grid square, it was possible to prepare a species list of the indicator species to be expected for these areas (ideal value). By means of the assignment of actually mapped breeding birds, as obtained from the breeding bird atlases, to the grid squares, the actual breeding bird occurrence was determined (actual value). From these ideal and actual values, a balance sheet of the occurrence of breeding bird indicator species in Berlin could then be prepared. Finally, for better assignment, the balance-sheet results were underpinned with a potential avifaunistic evaluation of the habitats (with reference to the index values according to Witt 1991), and a survey of the occurrence of Red Data Book species was compiled.

Certification of Breeding Bird Habitats

The basis of habitat mapping was the study of breeding bird habitat types of Germany north of the crest of the Central Mountains, as described comprehensively by Flade, from which the habitats occurring in Berlin were selected and supplemented by inclusion of the type Airports (cf. Flade 1994). The differentiated habitat types of young conifer forests were subsumed under the Type Conifer Thickets and Pole Woods. Altogether, 44 habitat types were distinguished (cf. Map Legend).

In the certification, only areas larger than 5 ha were considered; in cases of valuable mini-habitats (Bodies of Water, Gravel Quarries, Open Forest Bogs, Field Woods, Soft-Wood Riparian Forests, Sedge Marshes and Reed-Beds; the latter shown larger-than-scale), the minimum area size was 1 ha. These **minimum sizes** were considered, since the occurrence of demanding bird species is generally tied to a certain minimum area size. Also, the occurrence probability of characteristic bird species increases with area size (cf. Tab. 1, Fig. 3 and Bezzel 1982).

Tab. 1: Minimum Area Sizes for Investigations of Brood Bird Populations in Berlin (Flade et al. 1992)		
Landscape / Biotope Type	**1st Value** [1]	**2nd Value** [2]
Residential areas	5 ha	10 ha
Forests, meadows/pastures	1 ha	5 ha
Urban vacant areas, vacant fields	2 ha	5 ha
Structurally rich agrarian countryside, heaths, bogs, fallows, dumps	1 ha	10 ha
Structurally poor agrarian countryside	10 ha	25 ha
Reed-beds, small body of waters, quarries, special sites	100 m^2	1 ha

[1] 1st Value: Usual minimum area size for a significant avifaunistic investigation.

[2] 2nd Value: Area size for which an avifaunistic investigation should always be undertaken.

Tab. 1: Minimum Area Sizes for Investigation of Breeding Bird Populations in Berlin (Flade et al. 1992)
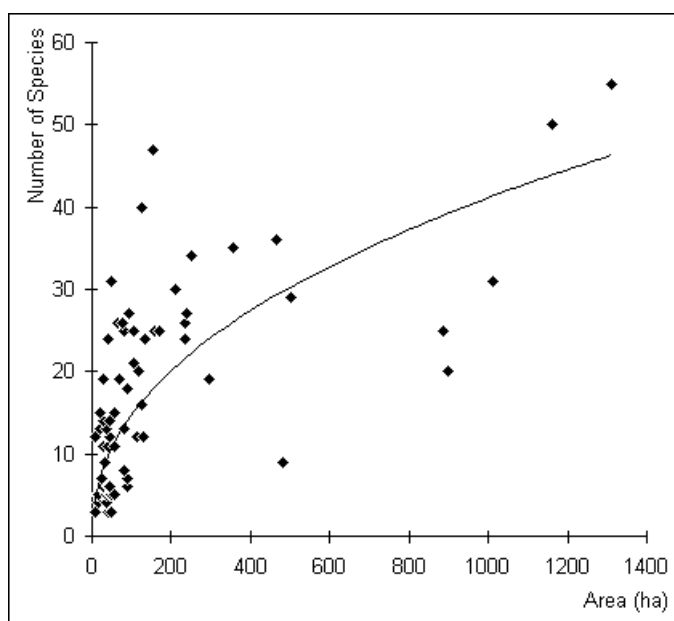
Fig. 3: Species-area Curve for Inland Meadows and Pastures (Flade 1991)

For reasons of representability, canals and all other linearly distinctive habitats, such as railroad embankments, ditches or wooded fringes, were not considered.

Decisive for the **assignment of an area** to one of the 44 classes was its structure (type of vegetation, type and density of development) and use. This is also true for mosaic areas (several habitat types in a small area) and special areas, for which case-by-case decisions were made. Thus, a mosaic area consisted of allotment gardens, dry ruderal areas and tree nurseries was assigned to the class allotment gardens, since its structure was generally very allotment garden-like. Recultivated dumps as examples of special areas were assigned either to the class dry ruderal areas or to the class parks,

depending on their structure and condition. In sum, almost all classes were supplemented by case-by-case assignments of similar structures, which was always preceded by a thorough examination with aerial photography.

Subsequently, all **open space losses** after 1980 were marked, in order to obtain a comparable reference time of mapped habitat types and breeding bird mappings. Small-area islands and fringes of changed use thus created were likewise excluded, since in these cases, negative influences at the edges of the open spaces can be assumed.

Ascertainment of the Species Lists by Grid Square (Ideal Value)

To be able to use the grid mapping of the breeding bird atlases, **indicator species lists** were prepared for each grid square.

For this purpose, the habitat map was first of all overlaid with the grid from the atlases. Since the map grid squares differed in the two breeding bird atlases, small areas along the former boundary between East and West Berlin could not be covered, and no balance-sheet could be prepared for them.

Subsequently a **habitat type list** was prepared for each grid square through summation, whereby only the splinter areas at the grid boundaries remained unconsidered. Small-area habitats, too, were incorporated in the list, and primarily associated, if necessary, to a grid square.

Flade assigns each breeding-bird habitat to a **potential indicator species group** (cf. Tab. 2).

Tab. 2: Indicator Species Groups of Alder Swamps (Flade 1994)

Alder Swamps (Cari elongatae - Alnetum medioeuropaeum)

Indicator Species:	Continuity for Investigation Areas of 10 ha or Greater (in %)
Thrush nightingale (Luscinia luscinia)	17
Crane (Grus grus)	14
Lesser spotted woodpecker (Dendrocopus minor)	52
Water rail (Rallus aquaticus)	33
Woodcock (Scolopax rusticola)	29
River warbler (Locustella fluviatilis)	19
Penduline tit (Remiz pendulinus)	14
Red-spotted bluethroat (Luscinia svecica)	10

Tab. 2: Indicator Species Groups of Alder Swamps (Flade 1994)

Using the work of Flade as a standard, and with consideration of the breeding bird species found in Berlin according to the Red Data Book of breeding birds (Witt 1991), indicator species groups were formed for the 44 Berlin habitat types. In cooperation with Berlin ornithologists, the supplementary habitat type Airports and the comprehensive type Conifer Thickets and Pole Woods were also provided with indicator species groups, and Dry-Shrub Ruderal Areas and Ruderal Areas were modified (cf. Tab. 3).

Tab. 3: Adjusted Indicator Species Groups

Habitat Type	Indicator Species
Conifer thickets and pole woods:	pine jay
	bullfinch
	dunnock
	willow warbler
	woodlark
Dry shrub vacant areas, ruderal areas:	rock dove
	black redstart
	whitethroat
	lesser whitethroat
	marsh warbler
Airports:	skylark
	wheatear
	tawny pipit

Tab. 3: Adjusted Indicator Species Groups

A total of 118 breeding-bird species were covered (cf. Tab. 4).

Tab. 4: List of Species Covered

acorn jay	hooded crow	redstart
ash-headed wagtail	hoopoe	reed bunting
barn owl	house martin	reed warbler
barred warbler	house sparrow	river warbler
black kite	icterine warbler	robin
black redstart	jackdaw	rock dove
black tern	kestrel	rook
black woodpecker	kingfisher	sand martin
blackbird	lapwing	Savi's warbler
bullfinch	lesser spotted woodpecker	scarlet grosbeak
chaffinch	lesser whitethroat	sedge warbler
chiffchaff	linnet	serin
coal tit	little bittern	short-toed tree-creeper
collared dove	little crake	shoveller
common pochard	little grebe	skylark
coot	little owl	snipe
corn bunting	little ringed plover	spotted crake
corn crake	long-eared owl	spotted fly-catcher
crested grebe	long-tailed tit	stock dove
crested lark	magpie	swallow
crested tit	mallard	swift
cuckoo	marsh harrier	tawny owl
dunnock	marsh tit	tawny pippit
field fare	marsh warbler	thrush nightingale
fire crest	middle spotted woodpecker	tree creeper
gadwall	moor hen	tree sparrow
garden warbler	nightingale	water rail
garganey	nuthatch	wheatear
goldcrest	ortolan bunting	white stork
golden oriole	partridge	white wagtail
goldeneye	penduline tit	whitethroat
goldfinch	pheasant	willow tit
grasshopper warbler	pied fly-catcher	willow warbler
gray wagtail	pine jay	winchet
gray-leg goose	quail	wood pigeon
great reed warbler	red-back shrike	wood warbler
green finch	red-breasted fly-catcher	woodcock
green woodpecker	red-necked grebe	woodlark
green-gray shrike	red-spotted bluethroat	wry-neck
		yellow bunting

Tab. 4: List of the Species Covered

Some of these species occur only in one of the two city halves or have become extinct or lost since 1945; in the latter case, the possibility of restocking in Berlin still exists.

With the aid of the grid square-covered habitat type lists and the indicator species groups, it was ultimately possible to prepare a list of the indicator species to be expected for each grid square, the number of which was entered as the **ideal-value** in the balance.

Survey of the Actual Population

The grid square-related ideal-values thus ascertained were counterposed to the data of **actually encountered species (actual values)** from the breeding bird atlases. The occurrence of potential indicator species was checked by means of the ascertainment categories used in the atlases: B (possible range), C (probable broods) and D (certain broods), as well as for the black kite, by means of surface cross-hatching (range marking). Subsequently, the number of indicator species mapped in each grid square was determined and compared with the number of indicator species to be expected.

Grid squares with predominantly changed use since 1980 and grid squares with no major share of Berlin territory (grid squares on the border with Brandenburg) were not considered.

The balance sheet results are shown on the present map with the aid of the ideal and actual values and the proportional share of mapped indicator species (in 20 % stages). The bird species missing or encountered, respectively, may also be obtained from the resulting file.

Data for the distribution and population development of the individual species are listed in the breeding-bird atlases. More current and more detailed single-area investigations (test areas) can be requested from the literature file of the Berlin State Commissioner for Conservation (cf. *ÖKOGRUBE*).

Inquiry into the Potential Avifaunistic Value

The potential avifaunistic value should serve as background information for the estimate of the value of the indicator species groups missing or occurring (balance-sheet result).

The Red Data Book of breeding birds in Berlin (Witt 1991) contains index values in accordance with Bezzel (1980) for each of the bird species used (cf. Tab. 4). It describes the distribution of the species throughout the whole city (index A), their presence in major areas (index B), their range figures (index C) and their population development (index D); these were used in the present map to derive a simple sum (index A + index B + index C + index D = simple sum) as a measure for habitat evaluation (cf. Tab. 5).

Tab. 5: Index Values for the Evaluation of Bird Populations (Witt 1991)

A-Value	Distribution Level in %	B-Value	Species Present in Large Areas
9	up to 0.5	9	1
8	0.5 - 2	8	2 - 3
7	2 - 4	7	4 - 5
6	4 - 6	6	6 - 7
5	6 - 10	5	8 - 9
4	10 - 16	4	10 - 11
3	16 - 25	3	12 - 14
2	25 - 40	2	15 - 17
1	40 - 65	1	18 - 20
0	65 - 100	0	21 - 23

C-Value	Range Figures	D-Value	Population Development
9	1 - 3	9	extinct
8	4 - 6	8	persistent decline
7	7 - 15	7	partial decline
6	16 - 30	6	no clear trend; stable
5	31 - 75	5	some increase
4	76 - 200	4	persistent increase
3	201 - 400	3	new immigrants
2	401 - 1 000		
1	1 001 - 2 000		
0	> 2 000		

Tab. 5: Index Values for the Evaluation of Bird Populations (Witt 1991)

Only for two species, and in the special case of species lost or extinct since 1945, did new values have to be established in cooperation with Berlin ornithologists (cf. Tab. 6).

Tab. 6: Newly Determined Index Values

Species	Index A	Index B	Index C	Index D	Simple Sum
Pheasant (non-native)	3	3	4	6	16
Black-necked grebe (new immigrant)	9	9	8	3	29
Extinct or missing since 1945	9	9	9	9	36

Tab. 6: Newly Determined Index Values

Finally, with the aid of these sum-index values of breeding bird species, **average index values** were calculated for the indicator species groups of each Berlin habitat type, which were used, in cooperation with the Berlin ornithologists, for the formation by five evaluation levels for the Berlin breeding bird habitat types.

Class I thus contains bird habitats which are potentially especially rare in Berlin and/or offer declining or rare species suitable brood habitats; Class V, on the other hand, encompasses habitats which are widespread in Berlin, and are not home to any, or to hardly any, rare or declining species (cf. Tab. 7).

Class	Average Index Value	Habitat Type, with Reference Number Shown on Map
I	34.3	Fresh meadows and pastures (12)
I	32.8	Moist meadows (10)
I	31.3	Sedge marshes (8)
I	31.3	Little-wooded fields (11)
I	31.0	Forest bogs (9)
I	30.5	Streams (1)
I	30.5	Wood rich field passage (16)
II	27.0	Reed-beds (7)
II	27.0	Heaths (40)
II	26.6	Large shallow lakes (2)
II	25.3	Dumps and slag-heaps (41)
II	24.8	Richly-wood riparians and bogs (13)
II	23.9	Fishponds (4)
II	23.7	Small bodies of waters (3)
II	23.5	Damp fallows and pre-wood stage (15)
II	22.8	Open clear-cut areas and afforestations (18)
II	22.7	Airports (44)
II	21.5	(Semi-)dry meadows (39)
III	21.0	Conifer thickets and pole woods (26)
III	20.7	Sewage farms (14)
III	20.4	Birch swamps (20)
III	19.6	Alder swamps (19)
III	19.5	Vegetation-poor moist gravel quarries (6)
III	19.3	Sewage-treatment ponds (5)
III	19.1	Spruce forests (27)
III	18.7	Pure pine forests (29)
III	18.4	Dry gravel quarries (43)
III	18.3	Softwood riparian forests (22)
IV	17.3	Pine forests rich in deciduous tree (28)
IV	17.2	Beech forests (25)
IV	16.4	Villages (33)
IV	14.5	Hardwood riparian forests(23)
IV	13.6	Oak/hornbeam forests (24)
IV	12.6	Parks (30)
IV	12.3	City-center and old apartment-house areas (37)
V	11.0	Deciduous tree thickets and pole woods (21)
V	11.0	Tree nurseries (32)
V	9.5	New apartment-house areas
V	9.1	Cemeteries (31)
V	9.0	Industrial areas and railroad facilities (38)
V	8.0	Garden-apartment areas (35)
V	8.0	Vacant areas (42)
V	7.8	Allotment gardens (34)

Tab. 7: Potential Avifaunistic Evaluation of Habitat Types

Tab. 7: Potential Avifaunistic Evaluation of Habitat Types

Such conspicuous features of this value-level assignment as the relatively poor values for deciduous forests, ruderal areas, allotment gardens and garden-apartment areas, or the relatively good values for pine forests, dumps, old buildings and city center-areas, can be explained by the evaluation approach: The indicator species potentially occupying the respective habitat type show corresponding index-values according to Witt, 1991. The evaluation thus gives the **avifaunistic potential** of each habitat type, regardless of the actual condition and size of the individual habitat; it is not therefore referenced toward single areas.

Evaluation of the Breeding Bird Population According to Occurrences of Red Data Book Species

The number of Red Data Book species occurring per mapped grid square was determined with the aid of the breeding bird atlases and shown as a vignette. The species of the Classes 1 (threatened by extinction), 2 (highly endangered), 3 (endangered) and P (potentially endangered) of the Red Data Book of breeding birds in Berlin (Witt 1991) were used. In addition, populations of the species red kite, black kite, honey buzzard, hobby, sparrow hawk and raven which, for species protection reasons, are documented in the breeding bird atlases only by means of surface cross-hatching or not at all, were incorporated into the evaluation.

Map Description

Generally, an increase in ubiquitous and civilization-friendly species among the breeding bird species can be observed, while endangered and specialized or demanding species are declining. This is in principle due to anthropogenic environmental changes (habitats which are deteriorated, isolated or too small). In the short-term, however, natural population fluctuation can also occur, which is due to droughts or hard winters, small population sizes or high space requirements and a strong fluctuation dynamic and/or high mobility of a species.

The most endangered bird communities in Germany north of the crest of the Central Mountains are presently those on open farmland, followed by the bird communities of the moors, heaths, sedge marshes, bulrush-beds, alder swamps and moist inland grasslands (cf. Fig. 4).
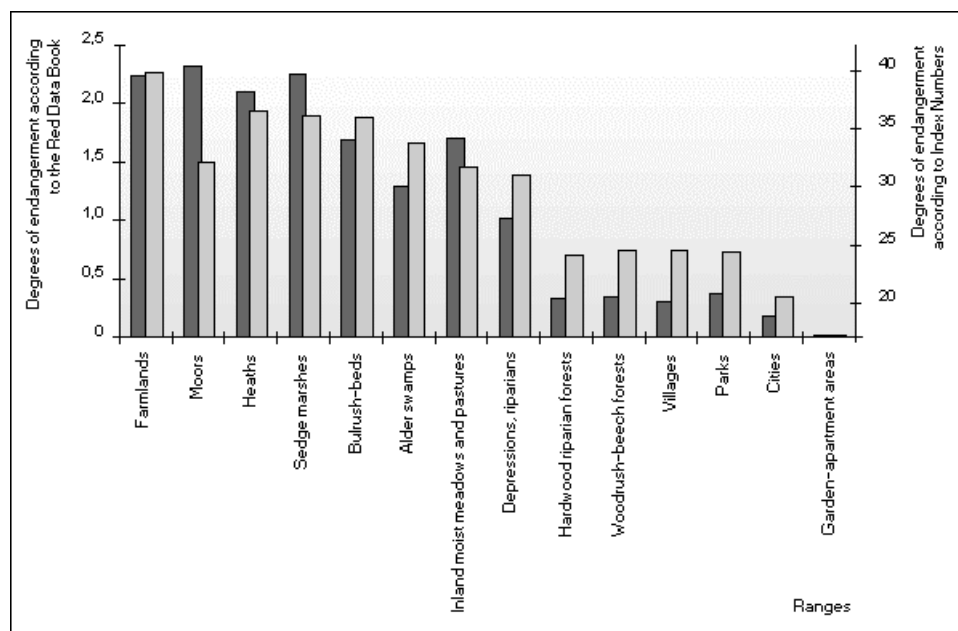
Fig. 4: Threat Degrees to Bird Communities in Northern Germany According to the Red Data Books and Index Numbers (Flade 1991)

In built-up areas, as the map shows, more abundant and less endangered indicator species occur (i.e. slight potential avifaunistic value, but abundant occurrence of typical species, and a good balance-sheet results). Undeveloped areas tend to be characterized by endangered and rare species (i.e. high potential avifaunistic value, but slight occurrence and poor balance-sheet results) (cf. Flade 1994).

Non-built-up areas in the city which are small and isolated (such as farmlands, meadows and forest strips) tend to be estimated too highly in the potential evaluation.

This gives reason to assume a good endowment of breeding bird habitats in settled areas. In Berlin, the residential-area habitats are especially extensive and typically distinctive, so that the corresponding indicator species can develop well. By contrast, the open landscape in Berlin is affected relatively negatively by small size and proximity to urban structures. Therefore, indicator species typical of open landscapes can settle there only with great difficulty.

An overview of the map reveals a relatively strong scattering of the balance-sheet values ascertained, even if areas with balance-sheet results tending in a very similar direction, and also transitional areas, can be determined. This scattering is explained by the fact that the balance-sheet was necessarily referenced not to single areas, but to grid squares of the breeding bird atlases, so that often different habitat types were rated jointly. In the case of airports, for instance, the adjacent areas (industrial areas, allotment gardens, or also the Airport Lake at Tegel Airport) located in the respective grid squares would always be included in the evaluation, so that different valuations emerged. The level at which analyses and statements are generated cannot therefore be the single area or the individual grid square. Rather, a larger area should be examined in its context. Thus, in grid squares with small indicator species groups, even the absence of one indicator species can mean the assignment of the grid square to another balance level (4 of 7 indicator species = level 40 - 60 %; 5 of 7 indicator species = level 60 - 80 %), although the mapped indicator species figures do not differ significantly. This applies to the area of South Kaulsdorf - South Mahlsdorf.

Nevertheless, areas with generally good and generally poor balance-sheet results are separated relatively clearly from each other.

Good balance-sheet results (60 - 100 %, i.e. a high level of agreement between expected and actual indicator species populations) could be ascertained especially in areas with garden-apartment and single-house development; other inner-city areas, too (old-town areas, mixed areas, industrial areas, allotment gardens, cemeteries, parks), did quite well in some cases. These are, however, precisely the areas to which slight avifaunistic value was attributed. More remarkable are therefore some undeveloped areas with good balance-sheet results, around the Spandau Forest and the Falkenhagen Field, where living conditions for the indicator species examined were evidently more favorable than in other forested or agricultural areas of Berlin.

Especially good balance-sheet results were obtained in the areas Zehlendorf / Lichterfelde / Dahlem, Reinickendorf / Wittenau / Tegel, Pankow / Wilhelmsruh and Karlshorst / Lichtenberg / Friedrichshain / Mitte / Friedrichsfelde / North Biesdorf.

Rather **poor balance results** (0 - 40 %, i.e. slight agreement between the expected and actual indicator species populations) were achieved in non-built-up areas on the edge of the city. These include particularly agricultural areas, bodies of water and banks of bodies of water, which are, however, of especially great potential avifaunistic value, as well as many forest areas of medium avifaunistic value. In general, indicator species groups appear here which contain larger numbers of demanding and rare species; however, their habitats are subjected to high use pressure through recreation-seekers, athletes, agriculture or a high pollutant load. Additionally, the habitats are frequently isolated and very small (such as reed-beds, small bodies of waters or farmlands), which leads to large indicator species groups per grid square; however, their occurrences are less probable, and/or hardly to be expected in reality.

Also showing poor balance-sheet results are abundantly structured areas with likewise large grid square indicator species groups, but only small-area habitat types. These include some built-up areas with relatively poor balance-sheet results, for instance, garden-apartment areas with interspersed agricultural areas, lakes and reed-beds, allotment gardens and tree nurseries or ruderal areas.

Areas characterized by forestry and bodies of water display especially poor balance-sheet results. These include areas such as Haselhorst / Tegel Lake / Tegel Airport / Heiligen Lake, Havel / southern Grunewald Forest / Wannsee and Müggel Lake / Müggelberge Hills / Dahme. Likewise showing poor balance-sheet results was the agriculturally-characterized area around Blankenfelde / Karow / Wartenberg.

A comparison of the potential avifaunistic evaluation of the Berlin areas with the occurrence of Red Data Book species tends to lead to very similar conclusions. Striking, however, are the body-of-water and airport areas. These have been assigned high potential avifaunistic values; however, they are home to only few Red Data Book species. The small and isolated inner-city near-natural single areas,

which have evidently been too highly classified in terms of their potential avifaunistic value (such as farmlands and bodies of water), are likewise hardly inhabited by any Red Data Book species.

Rare and endangered bird species are to be found mostly on the outskirts of town. Particularly undeveloped areas with a near-natural vegetation structure, especially agricultural areas, show a high number at Red Data Book species. These include the Gosen meadows, Tegel Creek, Köppchen Lake, Karow ponds, the Spandau Forest and the Gatow/Kladow fields. Especially in the area around Gosen, many endangered species can be attested.

If one compares the **East and West parts of Berlin**, some differences become obvious.

In the eastern part of the city, significantly more extensive areas with use changes are to be found than in the western part. Thus, even worse indicator species balance-sheet results are to be expected for the new residential areas in Marzahn, Hellersdorf and Hohenschönhausen, or in the reafforested sewage farms at Buch, than is apparent from the present map of exclusion areas (i.e., areas not incorporated into the evaluation due to essential use changes since 1980).

Some city center and old building areas in the eastern part of Berlin (Mitte, Friedrichshain, Lichtenberg) show better balance-sheet results than corresponding areas in the western boroughs (Kreuzberg). The major reasons to be cited here are the substantially more advanced reconstruction of the urban neighborhoods in the west, involving the destruction of nesting possibilities for indicator species, as well as greater density of the built-up city areas, with less open and vacant spaces. For this reason, a decline of the occurrence of breeding bird species must be expected due to the reconstruction and new building efforts in the eastern part of the city.

Overall, the areas with low potential avifaunistic values and few Red Data Book species did better in the balance-sheet than the more highly rated areas with more endangered bird species; thus built-up areas generally had better balance-sheet results than the undeveloped outer areas. Less endangered urban species evidently have better living conditions than the indicator species for more near-natural habitats. This is also evident from the avifaunistic valuation of the respective areas.

The result also demonstrates again the importance of certain minimum sizes for the occurrence of habitat-typical indicator species. It shows, too, that especially small inner-city near-natural areas decline in significance if they are without connection with other habitats.

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