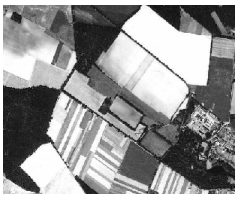

Vulnerability of bird communities in small mid-field afforestations: searching for a hierarchy of factors

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INTRODUCTION

- Habitats of an agricultural landscape are subject to permanent, negative changes, which in consequence lead to reduction of biodiversity.
- It is well known that mosaic, differentiated structure of agricultural landscape (especially presence of afforestations) markedly provide for preservation of different groups of animals, including birds.
- However, the size of those afforestations is usually relatively small, that is why natural processes are strongly influenced by adjacent areas.
- In most studies (in Poland as well as in other countries) the efforts were focused to the importance of structure of afforestations (their size, shape, vegetation etc.), ignoring the effects of environmental factors characterising near adjacent areas.

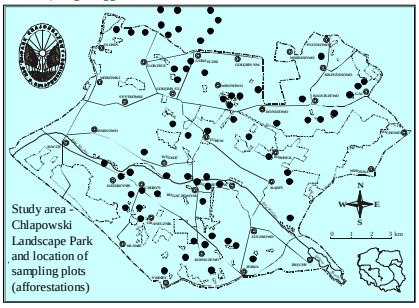
AIM OF STUDY

The aim of the study was to verify importance of three classes of factors for avifauna of small mid-field afforestations, i.e. factors related to:

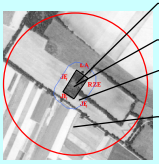
- structure of afforestation,
- structure habitat in neighborhood,
- structure of landscape.

Expected result of the research: recognition of a **hierarchy of the importance** of defined classes of factors, and better understanding the mechanisms, which shape avifauna of small mid-field woodland islands. It can contribute for **enhancing effectiveness of planting new afforestations** in terms of their importance for biodiversity preservation.

- The study (1999-2002) covered **66 mid-field afforestations** (0,06-3,10 ha) located mostly within the Gen. D. Chłapowski Landscape Park
- Main features of afforestations covered by the study: a) the area smaller then **3,5 ha**, b) length bigger then breadth not more then 3-fold.



Scheme of study - elements studied

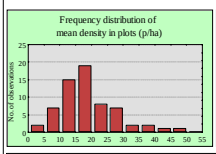


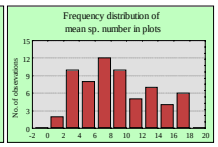
METHODS

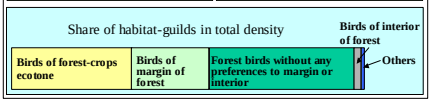
- **Bird population density** has been estimated with the aid of mapping method. Each plot was visited 9 times per breeding season, since 1.04 to 10.07. Duration of single visit in one plot (one afforestation) - 20-80 min.
- **Structure of afforestation** has been characterised by **16 variables** (qualitative, such as species composition of tree-stand, type of tree-stand, water conditions etc. and quantitative, such as area of afforestation, percentage cover of vegetation layers etc.) on the basis of field work and analysis of aerial photographs as well as maps.
- **Neighborhood** has been defined as the land adjacent to border-line of afforestation distant up to 50 m from the border-line, defined by MapInfo on the basis of aerial photographs. Structure of neighborhood (percentage of habitats and number of habitat patches) has been analysed with the aid of a software AreaMeasure. Finally, for further analyses **10 quantitative variables** have been used, such as share of grasslands, cereals, diversity index (H') and mean area of habitat patches.
- Analysis of **landscape structure** around given afforestation has been done in respect to a circle with the radius of 1,5 km from central point of afforestation, with the aid of aerial photographs. The structure of landscape has been analysed by MapInfo and AreaMeasure and finally **20 variables** have been defined (H', share of habitats, habitat patch number, wood isolation index (Gustafson i Parker 1994) etc.).
- In order to reduce number of independent variables a **principal factors analysis** has been performed, but only if combined variance represented by principal factors amounted to more then 75%. Finally, number of variables describing neighborhood has been reduced to 3, and number of variables characterising structure of landscape - to 11.
- All statistical analyses have been done with the aid of **Statistica 5.5.**

Bird community of studied afforestations:

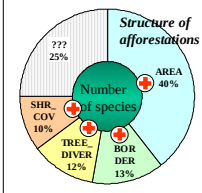
- 61 breeding species, total bird density - 15,1 pairs/ha
- Average bird density per plot - from 4,4 to 47,9 p/ha
- Average number of species per plot per year - from 1 to 18
- Total number of species per plot per year - from 3 to 27
- Most common (recorded in more then 50% of plots) species : F. coelebs, E. citrinella, T. merula, S. atricapilla , P. major, H. icterina, P. caeruleus, C. carduelis and M. striata.
- Most rare (recorded in single plots) species: T. pilaris, S. rubetra, P. modularis, P. pica, P. perdix, L. naevia, L. fluviatilis, J. torquilla, D. martius, C. oenas, A. atthis, A. scirpaceus.
- Most abundant species (dominance >5%): F. coelebs, S. atricapilla, E. citrinella, H. icterina and T. merula.







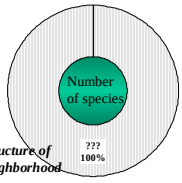
Influence of habitat structure on number of species

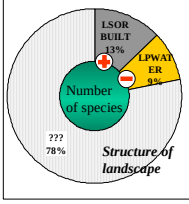


Positive effect — Negative effect
??? –unexplained variance

These „ring" figures show what part of variability in species number (or other bird attributes) may be explained by step-wise multiple regression (coloured part of a ring) and illustrate relative importance (%) of individual variable for analysed bird characters. E.g., (fig. on left) step-wise regression explains...

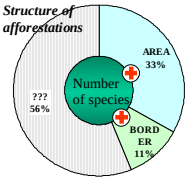
... 75% of variability of species number and shows that most important variable is AREA. One may see which class of variables is most significant for given attribute of bird community and which variable from given class is most important.





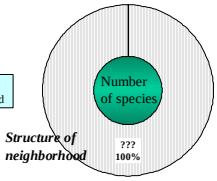
AREA - area of afforestation
BORDER - relative length of border-line of afforestation
SHR_COV - percentage cover of shrub layer
TREE_DIVER - diversity index (H') of species composition of tree-stand
LSORBUILT, LPWATER – see Fig. on right side

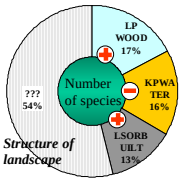
Influence of habitat structure on number of species of visitors (non-breeders)



AREA - area of afforestation
BORDER - relative length of border-line of afforestation

No variables in the model - no influence of neighborhood





LPWOOD - principal factor, correlated positively with number of wood patches and negatively - with number of large crop fields

LPWATER - principal factor, correlated positively with number of water bodies and index of isolation of afforestation

LSORBUILT - principal factor, correlated positively with share of woodland, and negatively - with share of built-up areas and orchards

Influence of habitat structure on species richness and abundance in „habitat-guilds"

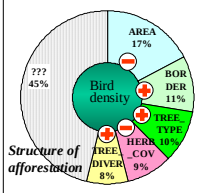
Determination coefficients of step-wise regression model in respect to „habitat-guilds": EDGE - Birds of forest-crops ecotone, W_EDGE - Birds of margin of forest, W_ALL - Forest birds without any preferences to margin or interior, W_IN - Birds of interior of forest, S - number of species, D - bird density

Habitat-guild	Structure of afforestation	Structure of neighborhood	Structure of landscape
EDGE_S	32		9
EDGE_D	35		26
W_EDGE_S	49		19
W_EDGE_D	33		–
W_ALL_S	68		33
W_ALL_D	45	9	42
W_IN_S	32		11
W_IN_D	23	5	10

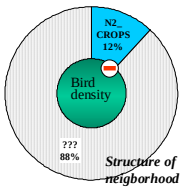
SUMMARY AND CONCLUSIONS

Variability of species number and bird density was most strongly related to structure of afforestations. Landscape structure influenced avifauna usually less (several-fold) then afforestation structure. Only for W_ALL and EDGE the effect of landscape structure was almost the same as the effect of afforestation structure. Effect of structure of habitat in neighborhood was very weak. The influence of habitat structure on community dynamics was relatively small, what suggests that changes in bird community in such small afforestations is random process or they are dependent on other factors, which have not been identified in this study.

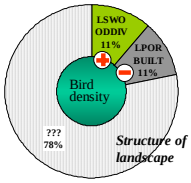
Influence of habitat structure on bird density



AREA - area of afforestation
BORDER - relative length of border-line of afforestation
TREE_TYPE - type of tree-stand; its value is higher when tree-stand is more leafy
HERB_COV - cover of herb layer
TREE_DIVER - diversity index (H') of species composition of tree-stand



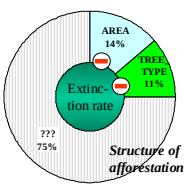
N2_CROPS - principal factor, correlated positively with share of crop fields and negatively - with share of woodland and grassland



LSWOODDIV -principal factor, correlated positively with share of woodland and diversity index and negatively - with share of large crop fields

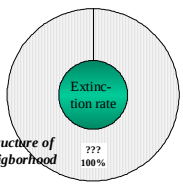
LPORBUILT -principal factor, correlated positively with number of patches with built-up areas and number of orchards, and negatively - with index of isolation of afforestations

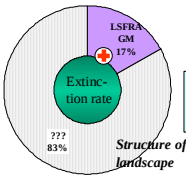
Influence of habitat structure on the rate of local extinction of breeding species



AREA - area of afforestation
TREE_TYPE - type of tree-stand; its value is higher when tree-stand is more leafy

No variables in the model - no influence of neighborhood





LSFRAGM - principal factor, correlated positively with share of small crop fields, and negatively - with share of large crop fields and shelterbelts.