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THE VEGETATION OF FOREST ISLANDS IN THE AGRICULTURAL LANDSCAPE OF THE JORKA RIVER RECEPTION BASIN IN THE MASURIAN LAKELAND (NORTH-EASTERN PART OF POLAND)

ABSTRACT: Investigations of the forest-island vegetation were conducted in the agricultural landscape of the Jorka river basin, within the Masurian Lakeland (north--eastern Poland). Eight forest islands of varying size (from 0.125 ha to 35 ha) were examined. Four of the greater ones represented planted pine forests (80 – 100 years old) and the remaining four — birch and aspen woods, naturally grown in deforested but not cultivated places. Lower layers of vegetation were indicative of a more or less advanced processes of development toward the Pino-Quercetum (Kozł. 1925 em. Mat. et Polak. 1955) association.

In this report, a geographic and geobotanic character of the investigated area was given, as well as a general characterization of forest islands and their edges. The studied ones were very closely examined.

KEY WORDS: Forest islands, mixed forest (Pino-Quercetum), forest edge, transition (transitory) zone, anthropogenic changes in plant communities, synanthropic species.

1. INTRODUCTION

As a part of a larger, collective volume, designed to give an evaluation of the ecological value of forest islands within the agricultural area of the north-eastern part of Poland, this report gives a characterization of their vegetation. The investigated forest islands differ from those in other regions of Poland, for instance from those in the Białystok Upland (F a l i ń s k i 1976) or in the West-Carpathian Foothills (D z w o n k o and L o s t e r 1988a, 1988b, 1989) — in their size, shape, age and origin, and, consequently, in their floristic composition and in the structure of their vegetation. They also differ from them in that they do not represent the remnants of natural forests, but are, nevertheless, representative of agriculturally exploited parts of the Masurian Lakeland. In this report, the first of the volume, we include a brief geographic characterization of the investigated area.

2. GENERAL GEOGRAPHIC AND GEOBOTANICAL CHARACTERIZATION OF THE INVESTIGATED AREA

The geographical coordinates of the area are: 53°65′ of northern latitude and 21°32′ of eastern longitude. According to physico-geographical regionalization of Poland that ties in with the regionalization of Europe, our area lies in the macroregion Masurian Lakeland (842.8) and borders with mesoregions Masurian Great Lakes (842.83) and Mrągovian Lakeland (842.82) (near town Mrągowo). It thus represents a part of the subprovince Eastbaltic Lakeland (842) that belongs to Eastbaltic Lowlands province and the East Europe region (Kondracki 1978).

Our region lies within the range of the last glaciation which left numerous lakes and a hilly relief. The surface of this lakeland is thus very diversified — it embraces hillocs of the terminal moraine, an undulated ground moraine and depressions of lakes, as well as rivers and post-glacial kettle lakes, for the most part overgrown and peaty.

Soils in the investigated area are also diversified. They originate mainly from glacial formations: from sandy clays and clayey sands. Boggy soils of holocene origin are also found in the area.

The climate of this region is rather continental, as evidenced by long and frosty winters (approximately 100 days with average daily temperature below 0°C and the average temperature in January −4.4°C) and by rather warm summers (average temperature in July +17.5°C). The monthly amplitude during the year is thus considerable (22°C) and the average yearly temperature is rater low (6.8°C). The snow cover subsists for approximately 90 days and the vegetation season is short (180—190 days). Spring comes late and the autumn — early. Yearly sum of atmospheric precipitation amounts to about 580 mm (Bajkiewicz—Grabowska 1985). Nevertheless, in comparison with other regions of the Masurian Lakeland, our area — lying in the immediate vicinity of Great Lakes that have a mellowing influence on the climate — has a shorter period without frost and the snow lies for a slightly shorter time.

According to the Szafer's geobotanical classification (1972), the investigated area belongs to the Masurian Lakeland District, the Mazury—Kurpie Section, the Northern Division of the Lowland-Highland Subprovince, Central European Province and to the Eurosiberian Region. It lies immediately beyond the north-eastern border of the beech tree range and at the south-western border of the boreal reach of the spruce. Spruce is an expansive species there and occurs in all types of forest communities.

The vegetation of the Jorka river basin to which the investigated area on Jorzec Lakeshore belongs was recently studied by P o l a k o w s k i et al. (1986). In their opinion, pine forests (Peucedano-Pinetum Mat. 1962 (1973)) prevail in the area. Apart from them, in depressions, small fragments of wet alder woods of Carici elongatae-Alnetum R. Tx. et Bodeau 1955 appear, as well as shrubbery belonging to the Salici-Franguletum R. Tx. 1937 association. On the other hand, on the map of potential natural vegetation (showing not the actual state of the forest but the productive capacity of its habitats), the Jorka river basin is situated within a deciduous forest Tilio-Carpinetum Traczyk 1962 habitat. And indeed, in the investigated area, pine forests are practically absent. Those planted about 100 years ago as one-species plantations (*Pinus silvestris*) have already turned — or are in the process of turning — into a mixed forest (Pino-Quercetum Kozł. 1925 em. Mat. et Polak. 1955). This is evidenced by the tree undergrowth and the shrub- and herb layers. Since remnants of the forest in the agricultural basin of lake Jorzec are rather small, they do not appear — understandably — on the small-scale (1:300000) map of F a l i ń s k i (1971).

Until the end of the XV century, East-baltic Lakeland was covered with dense, uniform forests. Human settlements were few and far between and they did not affect the forest-type character of the vegetation in the area. The colonization of this region and the resulting cutting of forests greatly increased during the XVI century. Forests were gradually partitioned into smaller forest complexes, separated by cultivated fields. At that time, deciduous trees prevailed and their share was still considerable as late as the end of the XVII century. During the XIX century, the share of conifers in the forests of our area greatly increased and toward the end of it — they prevailed over the deciduous species. This brought about many natural disasters, such as windfalls, forest fires and various calamities caused by pests. Toward the end of the century, the lotting out of private forests was allowed. All this resulted in the reduction of forest surface by about 40%. But since the beginning of the XX century, a rational forestry was introduced in this area. Unfortunately, in our country, the latter favored the cultivation of the pine. The spruce spreads spontaneously in all stands of tree of the area (D z i e j e ... 1965).

At present, land use in the Jorka river basin is as follows: forests — 16.7%, meadows and pastures — 23.4%, cultivated fields — 43.1%, lakes — 9.8% and other grounds — 7% (P o l a k o w s k i et al. 1985). This area is thus used mainly for agriculture.

3. METHODS

For purposes of our study, we based our choice of forests and woods on our previous familiarity with the landscape. We chose forests and woods that were typical and representative of the agricultural character of the lake Jorzec neighbourhood and thus — of all other agriculturally utilized parts of the Masurian Lakeland. They are not remnants of natural forests but of those planted and exploited by man or are simply small woods spontaneously grown amidst fields on deforested places.

Studies of the vegetation of those remnants of forests and mid-field woods were conducted in the years 1987–1990, usually in the middle of every month during the vegetation season. At the beginning (1987–1988), those studies bore a rather floristic character and later (1988–1990) — a phytosociological one. As far as smaller forest islands (up to 1.5 ha) were concerned, floristic studies were carried out on their entire surfaces, unless some of their parts (such as soggy depressions with a distinctly different vegetation or mid-forest meadows) had to be excluded from investigations. On two biggest islands (13.5 and 35 ha) studies embraced surfaces of about 1–1.5 ha, where zooecological investigations were conducted at the same time. Excluded from the study were cart-roads crossing those forests but species growing on foot-pathes were taken under consideration. Results of those studies are shown in the Table 1 that gives an idea of the floristic composition and stratification of the investigated woods. The table is also used as basis for further calculations and conclusions. At the same time, the floristic composition of the forest-edge communities was also studies.

On the basis of this table, the share of forest and non-forest species in the islands' vegetation was calculated. To this end, characteristic species of syntaxonomic groups (classes of associations according to Matuszkiewicz 1981) were used (Tables 4, 5).

In the years 1988 and 1989, phytosociological studies were conducted by the Braun-Blanquet method, universally accepted in Middle Europe (Pawłowski 1972). Records were made deep inside islands, on their edges, the edges of fields and deep inside of them (Table 2 and 3). Table 6 was put together on the basis of eight such lists. It shows floristic differences between communities in the transitory zone from forest to field. The investigations were carried out on southern, south-eastern and south-western sides of islands and on adjacent parts of forest and field — where zooecological studies were conducted.

Plant communities of forest islands and their field surroundings were classified as equivalent communities of the particular potential natural associations (Tüxen 1956). Field habitats were classified on the basis of spontaneously developing field weeds communities. An additional basis for their classification was a large mid-field belt of woods that represented a remnant of Tilio-Carpinetum Traczyk 1962, with all its characteristic species.

4. RESULTS

4.1. GENERAL CHARACTERIZATION OF INVESTIGATED FOREST ISLANDS

For our studies, we chose eight forest islands spread over a surface of about 10 km^2. Seven of them lie in the immediate vicinity of lake Jorzec (on the lake shore itself or not more than 0.5 km distant from it). The distance between them is a few hundred meters to 1.5 km. One of them lies across the lake and is thus more isolated from the others. Only one of those islands is about 4 km distant from the complex of the remaining ones and is surrounded by a vast expanse of cultivated fields (Dąbrowska-Prot 1991 — a map).

Grounds around the lake Jorzec were apparently ploughet and cultivated wherever the terrain was suitable to the cultivation. The soils under cultivated fields are thus more fertile and, above all, easier to cultivate than those under remnants of forests and mid-field woods. Those small wood lots are situated either on poorer soils, unprofitable from the point of view of agriculture — or on sandy or rocky elevations or in depressions, often marshy or even with noticeable water pools — all of them plainly not suitable for cultivation.

Forest islands chosen for our study are of various size — from 0.125 ha to 35 ha. They also vary as to their origin. Four of them are remnants of large forests: of pine planted about a hundred years ago. After a century of growth, they already show, in accordance with their habitat, the characteristics of a mixed forest (Pino-Quercetum Kozł. 1925 em. Mat. et Polak. 1955). The remaining four are birch and aspen woods spontaneously grown on deforested but not cultivated plots. As is evident from the analysis of the vegetation of those woods, they also occupy the habitat of a mixed forest.

The vegetation of the largest islands (mixed forests 1 and 2) is more differentiated than that of the smaller ones because of the variety of their habitats resulting from the earth relief. But it was studied on plots of about 1 ha, relatively uniform as to habitat and vegetation. Two of the birch and aspen woods are considerably depressed in their centers (more or less filled with water, depending on the season of the year or the weather) — and thus show the greatest differentiation. Their floristic composition is shown in Table 1.

Forest islands around the shore of lake Jorzec differ from each other by: (a) their origin, (b) their size, (c) their situation in relation to the earth relief, particularly the presence or absence of water pools, (d) their situation within the agricultural landscape and, above all, their distance from human settlements.

The question thus arises how those differences influence the composition and structure of plant communities of forest islands and, particularly, their synanthropization, that is, their deformation from natural plant communities compatible with the habitat.

4.2. DETAILED CHARACTERIZATION OF THE FOREST-ISLAND VEGETATION

4.2.1. Mixed forests, Pino-Quercetum

I classified remnants of planted pine forests as mixed forests Pino-Quercetum (Kozł. 1925 em. Mat. et Polak. 1955), although in the high-tree layer (a_1) the pine prevails. Sometimes it is accompanied by spruce which in the Northern Division appears in all types of forest communities. Trembling aspen (*Populus tremula*) and birches (*Betula verrucosa* and *Betula pubescens*) are also growing there. They are pioneer species that — as anemochoric — develop from seeds brought by wind to

Table 1. Plant communities of forest islands on the Lake Jorzec in the Masurian Lakeland

Number of forest island	Vegetation layer	1	2	3	4	5	6	7	8
Size of forest island (ha)		35	13.5	1.0	1.0	1.5	0.5	0.5	0.125
Cover of tree crowns (%)		50	30	50	50	40	70	50	40
Number of vascular plant species		54	53	53	66	53	52	74	52
Number of mosses species		6	4	4	3	2	2	1	2
Characteristic species of the associations classes (Ch.)									
Ch. Vaccinio-Piceetea									
Pinus silvestris L.	a_1	4	3	4	4	+	·	+	·
	a_2	(+)	(+)	·	·	·	·	·	·
Betula verrucosa Ehrh.	a_1	2	1	1	2	1	1	3	2
	a_2	+	1	+	·	1	1	1	1
	b	2	2	2	1	·	+	+	1
B. pubescens Ehrh.	a_1	+	+	1	1	2	2	+	+
	a_2	·	+	·	·	1	1	1	+
Populus tremula L.	a_1	·	+	·	·	3	3	3	3
	a_2	+	1	1	·	1	1	+	1
	b	+	·	+	+	·	3	+	3
	c	·	·	·	·	·	+	·	2
Picea excelsa (Lam.) Lk.	a_1	2	·	1	·	·	·	·	·
	a_2	+	·	·	·	·	·	·	·
	b	·	1	1	·	·	·	·	·
	c	·	·	·	+	·	·	·	·
Sorbus aucuparia L.	a_2	·	·	+	·	+	·	1	·
	b	1	2	+	2	1	+	1	2
	c	·	+	·	2	·	+	1	2
Juniperus communis L.	b	+	+	1	+	·	·	+	+
	c	+	+	+	+	·	·	·	1
Vaccinium myrtillus L.		+	·	+	·	·	·	1	·
V. vitis-idaea L.		3	·	2	·	·	·	+	·
Pirola secunda L.		+	·	·	·	+	·	+	+
Oxalis acetosella L.		3	+	2	1	·	·	·	·

Hieracium murorum L.		+	1	+	1	+	·	·	·
Melampyrum pratense L.		+	·	·	·	·	·	·	·
Solidago virga aurea L.		·	·	·	1	·	·	1	1
Convalaria maialis L.		+	3	1	2	·	·	·	·
Mycelis muralis (L.) Dum.		+	+	+	+	+	+	+	·
Majanthemum bifolium (L.) F. W. Schm.		·	+	+	·	·	·	2	·
Lycopodium annotinum L.		·	+	·	·	·	·	·	·
Ch. Querco-Fagetea									
Quercus robur L.	a_1	·	·	·	·	·	1	·	·
	a_2	1	1	+	+	1	1	+	1
	b	1	2	1	1	·	·	+	1
	c	·	1	·	·	·	·	+	+
Acer platanoides L.	a_2	+	1	+	·	·	·	·	·
	b	1	1	·	+	·	+	+	+
	c	·	+	·	·	·	·	+	·
Tilia cordata Mill.	b	·	+	·	+	·	·	·	+
Fraxinus excelsior L.	c	·	·	·	·	·	·	+	1
Padus avium Mill.	a_2	·	·	+	·	1	·	+	·
	b	1	2	1	·	2	1	+	+
	c	·	+	·	·	·	+	1	+
Corylus avellana L.	b	+	2	1	1	·	·	·	+
	c	·	·	·	+	·	·	+	·
Carpinus betulus L.	a_2	+	·	·	·	·	·	·	·
Frangula alnus Mill.	b	2	2	2	2	+	·	2	·
	c	·	·	·	·	·	+	1	1
Ribes schlechtendalii Lge.	b	+	·	1	·	1	·	·	·
	c	·	·	·	·	·	·	+	+
Lonicera xylosteum L.	b	·	·	·	·	·	·	1	·
	c	·	·	·	·	·	·	+	+
Hepatica nobilis Garsault		1	·	·	·	·	·	·	·
Aegopodium podagraria L.		+	·	·	·	·	·	·	·
Dryopteris filix-mas (L.) Schott.		1	1	+	2	+	+	·	·

Table 1, continued

No. of forest island	Veg. layer	1	2	3	4	5	6	7	8
Polystichum lobatum (Huds.) Chev.		+	+	+	.	+	+	.	.
Epilobium montanum L.		+	+	.	+	+	+	+	.
Carex digitata L.		1	.	.	.	.	.	+	.
Equisetum silvaticum L.		.	+	.	.	+	+	+	+
Moehringia trinervia L.		+	+	1	2	+	+	+	.
Galeobdolon luteum Huds.		.	.	.	.	+	1	.	.
Actea spicata L.		.	.	.	.	.	1	+	.
Stellaria holostea L.		.	.	.	.	.	.	+	.
Other forest species									
Humulus lupulus L.	b	+	1	1	.	1	1	.	.
Pirus communis L.	b	+	.	.	+	+	+	+	+
Malus silvestris (L.) Mill.	b	.	+	.	+	.	.	.	.
Cerasus avium (L.) Moench.	b	.	.	+	.	.	.	.	+
Alnus glutinosa (L.) Gaertn.	a_1	.	.	.	.	1	+	.	.
	b	.	.	.	.	+	.	.	.
Luzula pilosa (L.) Willd.		+	.	.	.	.	.	+	.
Solanum duicamara L.		.	+	.	.	+	+	.	.
Geranium robertianum L.		+	+	+	.	.	+	+	.
Geum urbanum L.		+	+	1	1	+	1	+	.
Veronica officinalis L.		+	+	+	.	.	.	.	.
Holcus mollis L.		.	.	.	.	+	.	.	.
Ch. Epilobietea anqustifolii									
Salix caprea L.	a_1	.	.	.	.	1	1	+	.
	a_2	.	.	.	.	.	+	+	.
	b	+	+	.	+	.	1	.	.
	c	.	.	.	+	.	+	.	.
Sambucus racemosa L.	b	1	1	1	1	+	.	.	.
	c	+	.	.	+	.	.	.	.
S. nigra L.	b	+	1	+	+	1	.	+	.
	c	+	.	.	.	.	.	.	.
Viburnum opulus L.	b	+	1	.	+	+	.	+	+
	c	.	.	.	.	.	+	.	.
Rubus idaeus L.	b	1	2	3	3	2	2	3	.
	c	+	+	+	+	+	+	+	+

Galeopsis bifida Boenn.		+	+	+	+	+	+	·	·
Fragaria vesca L.		+	2	+	+	+	+	+	·
Chamaenerion angustifolium (L.) Scop.		+	+	+	+	+	+	+	·
Urtica dioica L.		+	+	+	+	+	+	+	·
Galeopsis tetrahit L.		·	+	+	+	+	·	·	·
Calamagrostis epigeios (L.) Roth.		·	+	·	·	·	·	·	·
Hieracium umbellatum L.		·	·	·	·	·	+	+	+
Ch. Rhamno-Prunetea									
Rhamnus cathartica L.	b	·	+	+	+	+	·	+	1
	c	·	·	·	·	·	·	·	1
Crategus monogyna Jacq.	b	·	·	+	+	+	1	+	+
	c	·	·	+	·	·	·	·	2
Cornus sanguinea L.	b	·	·	·	·	·	·	+	·
Rosa sp.	b	·	·	·	·	·	·	·	+
Ch. Trifolio-Geranietea									
Trifolium alpestre L.		·	·	·	·	·	·	+	·
Medico falcata L.		·	·	·	·	·	·	+	+
Galium verum L.		·	·	·	·	·	·	·	+
Agrimonia eupatoria L.		·	·	·	·	·	·	·	+
Ch. Molinio-Arrhenatheretea									
Rumex acetosa L.		+	+	·	+	+	+	·	·
Dactylis glomerata L.		+	+	+	1	+	+	1	1
Galium molugo L.		+	+	+	+	+	+	1	+
Knautia arvensis (L.) Koult.		+	+	+	+	·	+	+	+
Poa pratensis L.		+	·	·	+	·	+	+	1
Molinia coerulea (L.) Moench.		·	+	·	+	+	·	·	·
Anthriscus silvestris (L.) Hoffm.		·	+	+	+	+	1	+	+
Festuca rubra L.		·	·	+	+	·	·	+	2
Heracleum sphondylium L.		·	·	+	·	·	·	+	1
Deschampsia caespitosa (L.) P.B.		·	·	+	1	+	+	+	·

Table 1, continued

No. of forest island	Veg. layer	1	2	3	4	5	6	7	8
Cerastium vulgatum L.		.	.	.	+	.	.	.	.
Alchemilla pastoralis Buss.		.	.	.	+	.	+	.	.
Senecio jacobea L.		.	.	.	+	.	.	.	+
Lysimachia vulgaris L.		.	.	.	.	+	.	.	.
Vicia cracca L.		.	.	.	.	.	+	.	.
Ranunculus acer L.		.	.	.	.	.	+	.	.
Arrhenatherum elatius (L.) P.B.		.	.	.	.	.	+	.	2
Taraxacum officinale Web.		.	.	.	.	.	+	+	2
Achillea millefolium L.		.	.	.	.	.	+	+	+
Trifolium pratense L.		.	.	.	.	.	.	+	.
Campanula patula L.		.	.	.	.	.	.	+	.
Plantago lanceolata L.		.	.	.	.	.	.	+	.
Prunella vulgaris L.		.	.	.	.	.	.	+	.
Chrysanthemum leucanthemum L.		.	.	.	.	.	.	+	1
Ch. Festuco-Brometea									
Pimpinella saxifraga		.	.	+	.	.	+	+	+
Ranunculus bulbosus L.		.	.	.	+	.	.	.	.
Centaurea scabiosa L.		.	.	.	+	.	.	+	.
Artemisia campestris L.		.	.	.	.	.	+	+	+
Carlina vulgaris L.		.	.	.	.	.	.	+	.
Anthemis tinctoria L.		.	.	.	.	.	.	.	+
Poa compressa L.		.	.	.	.	.	.	+	+
Ch. Sedo-Scleranthetea									
Festuca ovina L.		+	1	+	.	.	+	2	.
Rumex acetosella L.		+	.	.	+	.	.	.	.
Dianthus delthoides L.		.	.	.	+	.	.	.	.
Trifolium arvense L.		.	.	.	.	.	.	+	+
Thymus serphyllum L.		.	.	.	.	.	.	.	+
Ch. Nardo-Callunetea									
Peucedanum oreoselinum (L.) Moench.		+	+	+	1	.	.	.	+
Sieglingia decumbens (L.) Lam.		.	.	+	.	.	.	.	.

Hieracium pilosella L.	·	·	·	·	·	·	+	·
Potentilla erecta (L.) Hampe	+	·	·	·	·	·	·	·
Other grassland species								
Arabis arenosa (L.) Scop.	+	·	·	·	·	·	·	·
Anthoxanthum odoratum L.	+	1	·	+	·	·	+	·
Campanula rotundifolia L.	+	·	+	·	·	·	+	·
Hypericum perforatum L.	·	+	+	·	+	·	+	+
Linaria vulgaris (L.) Mill.	·	+	·	+	·	·	+	·
Veronica chamaedrys L.	·	·	+	·	·	·	+	+
Trifolium montanum L.	·	·	+	·	·	·	+	1
Agrostis vulgaris With.	·	·	·	+	·	·	·	·
Glechoma hederacea L.	·	·	·	+	·	·	·	·
Silene inflata (Salisb.) Sm.	·	·	·	+	·	·	·	·
Sedum maximum Snt.	·	·	·	+	·	·	·	·
Phragmites communis Trin.	·	·	·	·	1	3	·	·
Mentha arvensis L.	·	·	·	·	+	+	·	·
Malachium aquatile (L.) Fr.	·	·	·	·	·	+	·	·
Ranunculus repens L.	·	·	·	·	·	+	·	·
Trifolium campestre Schres.	·	·	·	·	·	·	+	+
Briza media L.	·	·	·	·	·	·	·	+
Synanthropic species								
Stellaria media Vill.	+	·	·	·	·	·	·	·
Rudbeckia laciniata L.	·	+	·	·	·	·	·	·
Agropyron repens (L.) P.B.	·	+	·	2	·	+	·	·
Chelidonium maius L.	·	+	1	1	·	·	·	·
Impatiens parviflora D.G.	·	·	·	1	·	·	·	·
Viola arvensis Murr.	·	·	·	+	·	·	·	·
Artemisia vulgaris L.	·	·	·	+	+	+	+	+
Melandrium album (Mill.) Garcke	·	·	·	·	+	·	·	·
Equisetum arvense L.	·	·	·	·	+	·	·	·
Galium aparine L.	·	·	·	·	+	+	·	·

Table 1, continued

No. of forest island	Veg. layer	1	2	3	4	5	6	7	8
Bidens tripartitus L.		.	.	.	.	+	+	.	.
Polygonum dumetorum L.		.	.	.	.	+	.	+	.
Planted species									
Syringa vulgaris L.		.	.	.	1	.	.	.	.
Symphoricarpos racemosus Mchx.		.	.	.	+	.	.	.	.
Ligustrum vulgare L.		.	.	.	+	.	.	.	.
Vinca minor L.		.	.	.	1	.	.	.	.

pine plantations. Along with pine, they make part of the highest layer of trees. In the low-tree layer (a_2), besides birches and aspens, the oak appears and sometimes linden and maple occur. The shrub layer is mainly composed of *Frangula alnus* and *Sorbus aucuparia*, as well as of young oak and birch. In those communities, species characteristic of the class Vaccinio-Piceetea are also present. The classification of those communities to the group of mixed forests of the Dicrano-Pinion alliance is thus unquestionable (M a t u s z k i e w i c z 1981). Despite a small number of species that characterize the Pino-Quercetum and the paucity of its floristic composition in comparison with phytosociological records of Traczyk from the neighbouring forest inspectorate Strzałowo (K o t o w s k a 1989, T r a c z y k — unpublished), I number forest islands 1–4 among this association. Since spruce occurs in those communities and a differentiating species, *Pirola secunda*, was also found in them, the communities under discussion should be classified as belonging to Pino-Quercetum serratuletosum that occurs in the north-eastern part of Poland. Recently, that subassociation was raised to the rank of an association, Serratulo-Pinetum Matuszkiewicz J. M. (cited after M a t u s z k i e w i c z 1981). It occurs on light, stony soils — very similar to those under forest islands.

Forest No. 1 — a mixed forest of 35 ha — is situated north-east of the lake Jorzec and in its immediate neighbourhood, and partially on the slope of the lake Miałkie valley. The shape of this forest island is highly irregular, with many projections jutting out into fields and many bays of fields jutting into the forest. The standing timber is considerably but irregularly thinned out (crown cover is 30–70%). Judging from the undergrowth of trees and shrubbery and from the lightness of soil, it was planted in the habitat of mixed forest.

In the high-tree layer (a_1), apart from the predominating planted pine, the spruce (*Picea excelsa*) and two species of birch (*Betula pubescens* and *Betula verrucosa*) occur. In the low-tree layer (a_2), the pine is extremely sparce — I found only a few drying specimens. Oak and spruce predominate, birch and trembling aspen appear now and then, and maple (*Acer platanoides*) is even more rare. In the shrub layer I did not find any pine. The herb layer is patchy; to a certain degree it depends on the differentiation of high and low trees (for instance, on the presence of spruce under which the soil is bare, covered only with needles).

Floristic composition and richness are shown in Table 1. On the surface of more than 1 ha (that was investigated from the zooecological point of view) I found 54 species of vascular plants and 6 — of the mosses.

Forest No. 2 — a mixed forest of 13.5 ha surface — is situated west of lake Jorzec, almost opposite the forest No. 1, partially on the slope of the lake's valley, on light and sandy soil. Similarly to the island described above, it has a very irregular surface, with jutting out projections. In professor Traczyk's opinion (personal information) it is now a mixed forest, although considerably deformed in consequence of human activity (cutting, planting of pine diminishing of forest surface: the latter obviously results in a stronger influence of agriculture). The floristic composition and richness of this forest show a distinct similarity to those of forest No. 1 (see Table 1). On the area under study, 53 species of vascular plants and 4 of mosses were found.

The high-tree layer is composed of pine, with the addition of two species of birch, some aspen, oak and maple. The crown cover is 20–50%. In the low-tree layer the same species occur but pines appear only as rare, drying specimens. Spruce is not found in either of those two layers of trees. Shrub and herb layers are considerably differentiated; in higher parts of the forest, with trees more thinned out, it is different from that in the lower parts, more densely covered with trees. We find there some depressed places, more humid, where pines are dying out and hop (*Humulus lupulus*) climbs up the tree trunks and shrubs. Infestation of those places with alien species is different than that of the rest of the island. According to Traczyk (personal information), in those places liquid manure was poured out or surplus of cow dung was deposited.

Forest No. 3 — a small remnant of a mixed forest, situated on the eastern side of lake Jorzec, close to it and to the forest No. 1 (about 50 m distant). Apparently, until recently it formed a whole with this larger forest. The surface No. 3 lies on a small elevation and is surrounded on all sides by cultivated fields.

In the high-tree layer, pine strongly predominates, with a small addition of birch and a minimal one of trembling aspen. The crown cover is 30–60%. Among lower trees, oak, birch, maple and mountain ash occur. Lower, numerous shrubs appear and among them, undergrowth of all deciduous trees from higher layers is visible. Moreover, numerous shrubs of hazel (*Corylus avellana*) appear. In the herb layer we find a considerable share of coniferous forest species (for instance, *Vaccinium myrtillus*, *Oxalis acetosella*). The species composition of the vegetation (Table 1) is similar to that of forests No. 1 and 2. The floristic richness is also considerable despite the small surface of this little forest. I found 53 species of vascular plants there and 4 of the mosses.

Forest No. 4 is a remnant of a mixed forest of 1 ha surface, about 4 km distant from other investigated areas grouped together and from lake Jorzec. It lies a bit nearer (1.3 km) to the lake Głębokie. It is surrounded on all sides by cultivated fields and its distance from the closets farm buildings is only 0.5 km. Within this forest there is a depression open toward the fields, covered with a humid meadow. It does not come within the range of our studies: we investigate only the part covered with trees. This forest is somewhat younger than the previously described ones (is about 80 years old).

In this remnant of a planted pine forest the crown cover is 40–60%. In the high-tree layer pine prevails and birch is much more scarce. A thin layer of low trees is composed of oak, mountain ash (*Sorbus aucuparia*) and hawthorn (*Crategus monogyna*). Shurb layer cosists of young trees from both higher layers but without pine. In the species composition of the shrub layer, some species planted by man are found, for instance lilac (*Syringa vulgaris*) and privet (*Ligustrum vulgare*), because in this wood an old grave is situated. In the herb layer some garden species can be found, particularly in the immediate vicinity of the grave. In the herb layer of this wood some synanthropic species also occur. Generally, I registered in this wood 66 species of vascular plants and 3 of the mosses. At present, this little forest is used by inhabitants of the neighbourhood as an illegal refuse dump.

4.2.2. Spontaneously grown birch and aspen woods

Birch and aspen woods are composed of pioneer species that occupy mixed forest habitats deprived of vegetation. They are scattered among fields, on uneven parts of the terrain, in stony places, unsuitable for agriculture. They are — undoubtedly — stages in the succession from the shurb communities of clearings to the final mixed forest ones. It is evidenced by a considerable share of species typical of grasslands, which in smaller woods equal in numbers the forest ones. The classification of those woods as a succession stage of mixed forests is supported by the domination of aspen in the high-tree layer (a_1) and its presence in all lower layers. Also in the appearance of oak in the low-tree layer (a_2) and in the typical of mixed forests shurb layer composed of oak, birch, mountain ash and alder buckthorn (M a t u s z k i e w i c z 1981). In the herb layer, besides species typical of coniferous forests, such as *Mycelis muralis*, *Solidago virga aurea*, *Pirola secunda* and even *Vaccinium myrtillus* and *V. vitis idaea*, some species of deciduous forests occur, such as *Moehringia trinervia* and *Carex digitata* — and of shrub species primarily *Padus avium*.

There are two types of birch and aspen woods: those depressed in the centre, with a pool of water, and the dry ones. Woods with water pools are distinguished by the highest ecological diversity of plant, from distinctly hydrophylous species to those tolerating drought. This fact is obviously connected with the irregularity of the terrain and that of ecological conditions.

Wood No. 5 is a midfield woodlot of birch and aspen, of 1.5 ha. It belongs to a group of woods on the eastern side of lake Jorzec. It is of an elongated shape and in its centre there is an oblong depression without outflow (with a changing water level), overgrown with a dying forest. It was excluded from investigations. The surrounding higher and dryer part of the forest has its tree layer similar to other studied deciduous woods. In all probability, it came into being in the process of the secondary succession in a deforested place. Its central part, flooded now and then to various levels, is probably of natural origin.

The high-tree layer (a_1) is composed of two species of birches (*Betula verrucosa* and *B. pubescens*), of trembling aspen (*Populus tremula*) and of alders (*Alnus glutinosa*) — with an addition of willows (*Salix caprea*) and only a few, obviously dying, pines. In the lower-tree layer (a_2), the same species as in a_1 occur, with the addition of oak and mountain ash. The pine is absent. The crown cover is 30—50%. In the shrub layer (b), bird cherry (*Padus avium*) and raspberry bushes predominate, along with currant bushes (*Ribes schlechtendali*), buckthorn (*Ramnus cathartica*) and the undergrowth of trees, particularly oaks. Hop (*Humulus lupulus*) climbs up tree trunks and bushes. The herb layer is relatively sparce and floristically poor. Among the latter, reed (*Phragmites communis*) is conspicuous: in places it reaches even the forest edge. There are also some synanthropic species. Around the water pool some trees die and fall to the ground. Generally speaking, I found 53 species of vascular plants there and two of the mosses — less than in mixed forests.

Wood No. 6 surrounded by fields represents a birch and aspen woodlot of about 0.5 ha, lying on the eastern side of lake Jorzec, close of forest No. 1. Somewhat elongated, it has in its centre a deep pool sometimes filled with water. Our study covers its higher, dryer part.

The high-tree layer and the much thinner low-tree layer (a_1 and a_2) are composed of aspens and birches of both species, with a small addition of oaks and willows (*Salix caprea*). The crown cover is more dense: 50–80%. In the shurb layer, undergrowth of the same species appears, with aspen growing in great quantities. Alder buckthorn and raspberry (*Rubus idaeus*) are plentiful as well as hop on tree trunks and shrubbery, particularly on birches. In the herb layer, *Geum urbanum* and *Phragmites communis* occur. The latter is more and more dense, the closer it is to water pool. The herb layer is richer than in the previous wood. Generally taking, I found 52 species of vascular plants and 2 of the mosses.

Wood No. 7, a birch and aspen midfield woodlot of 0.5 ha, lies on the eastern side of lake Jorzec, close to the forest No. 1 and the woods No. 6 and 8. It is somewhat elongated and its central part is elevated. The soil in this wood is stony.

The high- and low-tree layers (a_1 and a_2) are composed of birch and aspen, with the addition of single pines and in the lower layer of oak, mountain ash and willow. The crown cover is about 40%. The shrubbery layer is rich in species. In its larger portion raspberry strongly prevails; young birches and oaks are also noticeable. The herb layer is also rich in species, among which the grassland ones and even the thermo- and photophilous ones are present. All in all, I found 75 species there — 74 of vascular plants and 1 of mosses. It is thus the richest community of all eight subject to our investigation.

Wood No. 8 is a birch and aspen midfield woodlot of 0.125 ha, the smallest of all investigated ones. It is situated in a group of woods on the eastern side of lake Jorzec, on a small, stony elevation by the road. It is surrounded by fields.

The high-tree layer (a_1) is composed of aspen with an addition of birch (*Betula verrucosa*). Among low trees, aspen dominates and also some birches, oaks, mountain ash and linden appear. The crown cover is about 40%, like in the previous wood. In the shrub layer, young trees of the above mentioned species prevail, and besides, hawthorn (*Crategus monogyna*) and bird cherry (*Padus avium*) occur. In the herb layer, seedlings of trees from the forest roof and those of the ash tree appear. Hawthorn, roses, currant bushes and alder buckthorn are also found. Among herb-layer plants, there are numerous species typical of grasslands. Together, I found 52 species of vascular plants here, as well as 2 of mosses.

4.3. GENERAL CHARACTERISTICS OF FOREST-ISLAND EDGES VEGETATION (ECOTONE)

Forest edges or transition zones of varying width between forest and non-forest communities are elements of particular interest as far as the forest's inner differentiation is concerned. They differ from the forest interrior by both the floristic composition and the horizontal and vertical structure of vegetation. As a border belt, they play a considerable role in the exchange of components of plant communities between the forest and the surrounding treeless plant formations — in our case, cultivated fields.

The edges of studies forests and woods form a dozen-or-so meters wide belts and thus their share of the forest is the greater, the smaller is the forest itself. That is why, in the landscape of small forest islands, the share of the surface and the ecological value of forest edges is considerable. Therefore, I give here a general characterization of transition zones though their investigation is as yet not completed. A seperate report will be devoted to their ecological value.

Borders of the selected islands as well as borders of all forest islands in the area of our study are of artificial origin and are so maintained by man. They came into being through cutting of the forest — to the limits of agricultural profitability. Their borderlines do not change because yearly ploughing prevents the expansion of the forest.

Borders between forests and cultivated fields are sharp and visible from far away. The high wall of the forest formed by trees with branches sometimes descending as low as the ground is separated from the field by a narrow transition zone (one- to a few meters wide). Shrubbery and young trees are scarce, except raspberries that usually do not stand higher than high herbs.

An idea of the changing floristic composition in the transition from the forest interior, through its edge and the edge of the field, to the middle of the field — can be gained from the Tables 2 and 3. They show the transition zone of one of the mixed forest (surface No. 3) and one of the birch and aspen woods (surface No. 7).

Usually, the transition zone between forest and field can be divided into three parallel belts: the forest edge, the proper, grassy and bushy transition zone and the field edge. Trees of the forest edge have low branches, unlike those of inner forest that have branchess only in the upper parts of the trunk. The fact that the trees of the forest edge have branchess only in their upper parts indicates that the forest was recently cut down, that its border zone is quite young. Nevertheless, I found no example of such a forest island among those under investigation.

Forest edges of the Pino-Quercetum type that are remnants of large forests were artificially made by cutting. They consist mainly of pine, their dominant component. Most often, deciduous trees are only an addition — they usually represent lower layers of the forest (a_2 and b). There are few places where aspens or birches prevail in the forest edge.

Edges of birch and aspen woods are always composed of deciduous trees and shrubs. In some places birches prevail (*Betula verrucosa* and *B. pubescens*). In others — aspen (*Populus tremula*) whose branches often reach to the ground. On edges of woods with pools of water in the middle, many species of low trees (*Quercus robur*, *Padus avium*, *Salix caprea*) and shrubs grow — among others even hop (*Humulus lupulus*). In woods growing on elevations, species composition of the shrub zone is different and usually poorer from that of humid woods. Such trees and shrubs as *Sorbus aucuparia* and *Evonymus europaea* can be found there.

Around the majority of woods there is a narrow belt of shrubby vegetation composed of young deciduous trees of the same species as those inside the forest

Table 2. Transition zone from mixed forest to field (forest island No. 3, 1 ha)

Number of the record	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Environment of the record	forest's interior						forest's edge				field's edge				open field		
Cover of tree crowns (%)	50	60	30	50	35	40											
Number of vascular plants in the record	15	18	16	24	10	15	17	27	19	19	6	17	17	16	15	23	22
Forest species as follows below:																	
Ch. Vaccinio-Piceetea																	
Picea excelsa	V*	·	·	·	·	·	V	·	·	·	·	·	·	·	·	·	·
Sorbus aucuparia	V	V	·	·	V	·	V	·	·	V	·	·	·	·	·	·	·
Pinus silvestris	V	V	V	V	V	V	V	V	V	V	·	·	·	·	·	·	·
Betula pubescens	V	V	V	V	V	V	V	·	·	V	·	·	·	·	·	·	·
B. verrucosa	V	V	V	V	·	V	·	V	·	V	·	·	·	·	·	·	·
Populus tremula	·	V	·	V	·	V	·	V	V	·	·	·	·	·	·	·	·
Vaccinium myrtillus	·	V	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Juniperus communis	·	V	·	V	·	V	V	·	·	V	·	·	·	·	·	·	·
Oxalis acetosella	V	·	·	V	·	·	·	·	·	·	·	·	·	·	·	·	·
Mycelis muralis	·	·	·	V	·	·	·	·	·	·	·	·	·	·	·	·	·
Hieracium murorum	·	V	V	·	V	·	·	·	·	·	·	·	·	·	·	·	·
Ch. Querco-Fegatea																	
Quercus robur	V	V	V	·	·	V	V	·	·	V	·	·	·	·	·	·	·
Ribes schlechtendalii	V	·	V	V	V	V	·	·	·	·	·	·	·	·	·	·	·
Corylus avellana	·	V	·	V	·	V	·	·	·	·	·	·	·	·	·	·	·
Acer platanoides	·	·	V	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Padus avium	·	·	V	V	·	·	·	·	V	V	·	·	·	·	·	·	·
Evonymus verrucosa	·	·	·	·	·	V	·	·	·	·	·	·	·	·	·	·	·
Frangula alnus	V	V	V	V	·	·	V	·	·	V	·	·	·	·	·	·	·
Polystichun lobatum	·	·	V	V	·	V	·	·	·	·	·	·	·	·	·	·	·
Moehringia trinervia	·	·	·	V	V	·	·	·	·	·	·	·	·	·	·	·	·
Dryopteris filix mas	·	·	·	·	·	V	·	·	·	·	·	·	·	·	·	·	·
Ch. Alnetum glutinosae																	
Solanum dulcamara	·	V	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Other forest species																	
Humulus lupulus	V	·	V	V	V	·	·	·	·	·	·	·	·	·	·	·	·

Cerasus avium	.	.	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Geum urbanum	.	.	.	V	.	V	.	.	.	.	.	.	.	.	.	.	.
Pirus communis	.	.	.	.	V	.	.	.	.	.	.	.	.	.	.	.	.
Species of clearings and brushwoods																	
Ch. Epilobietea angustifolii																	
Chamaenerion angustifolium	V	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rubus idaeus	V	V	V	V	V	V	V	V	V	V	.	.	.	.	.	.	.
Sambucus nigra	V	.	V	V	V	V	.	.	.	.	.	.	.	.	.	.	.
S. racemosa	V	.	V	V	.	.	.	.	.	.	.	.	.	.	.	.	.
Galeopsis bifida	.	V	.	.	.	.	.	.	.	V	.	.	.	.	.	.	.
Fragaria vesca	.	V	V	V	V	V	.	.	.	.	.	.	.	.	.	.	.
Urtica dioica	.	.	V	V	.	.	.	.	.	.	.	.	.	.	.	.	.
Ch. Rhamno-Prunetea																	
Rhamnus cathartica	V	V	.	V	.	.	.	V	V	V	.	.	.	.	.	.	.
Crategus monogyna	.	.	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ch. Trifolio-Geranietea																	
Medicago falcata	.	.	.	.	.	.	.	V	V	.	.	.	.	.	.	.	.
Grasslands species																	
Ch. Molino-Arrhenatheretea																	
Heracleum aphondylium	.	.	.	V	.	.	.	.	.	.	.	.	.	.	.	.	.
Festuca rubra	.	.	.	.	.	.	V	V	.	.	.	.	.	.	.	.	.
Galium molugo	.	V	.	V	.	.	V	V	V	V	.	.	.	.	.	.	.
Dactylis glomerata	.	V	.	V	.	V	V	V	V	V	V	.	.	.	.	.	.
Achillea millefolium	.	.	.	.	.	.	V	V	V	V	.	.	.	.	.	.	.
Agrostis vulgaris	.	.	.	.	.	.	V	.	.	V	.	.	.	.	.	.	.
Taraxacum officinale	.	.	.	.	.	.	.	V	.	.	.	.	.	.	.	V	V
Knautia arvensis	.	.	.	.	.	.	.	V	V	.	.	.	.	.	.	.	.
Phleum pratense nodosum	.	.	.	.	.	.	.	V	V	V	.	.	.	.	.	.	.
Festuca pratensis	.	.	.	.	.	.	.	.	.	.	V	V	V	V	V	V	V
Trifolium repens	.	.	.	.	.	.	.	.	.	.	.	V	.	.	.	V	V
Trifolium pratense	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.	V	V
Ch. Festuco-Brometea																	
Artemisia campestris	.	.	.	.	.	.	.	V	.	.	.	.	.	.	.	.	.
Anthemis tinctoria	.	.	.	.	.	.	.	V	V	.	.	.	.	.	.	.	.
Centaurea scabiosa	.	.	.	.	.	.	.	V	V	.	.	.	.	.	.	.	.
Pimpinella saxifraga	.	.	.	.	.	.	.	V	V	.	.	.	.	.	.	.	.

Table 2, continued

No. of the record	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ch. Sedo-Scleranthetea																	
Festuca ovina	.	V	.	.	.	.	.	V	V	V	.	.	.	.	.	.	.
Rumex acetosella	.	.	.	.	.	.	.	V	.	.	.	.	.	.	V	.	.
Ch. Nardo-Callunetea																	
Sieglingia decumbens	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Veronica officinalis	.	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Other grasslands species																	
Linaria vulgaris	.	.	.	.	.	.	V	V	.	.	.	.	.	.	.	.	.
Galeopsis ladanum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.
Arenaria serpyllifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.
Stellaria graminea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V
Synanthropic species																	
Consolida regalis	.	.	.	.	.	.	V	.	.	.	.	.	.	.	.	.	.
Convolvulus arvensis	.	.	.	.	.	.	V	.	.	.	.	.	.	.	.	.	.
Agropyron repens	.	.	.	.	.	.	V	V	V	V	V	V	V	V	V	V	V
Cirsium arvense	.	.	.	.	.	.	.	V	.	.	.	.	V	.	V	V	V
Polygonum convolvulus	.	.	.	.	.	.	.	V	.	.	.	.	.	V	V	V	V
Melilotus officinalis	.	.	.	.	.	.	.	V	.	.	.	.	.	.	.	.	.
Artemisia vulgaris	.	.	.	.	.	.	.	V	V	V	V	V	V	V	V	V	V
Sonchus arvensis	.	.	.	.	.	.	.	V	V	.	.	V	V	V	V	V	V
Setaria viridis	.	.	.	.	.	.	.	.	.	.	V	V	V	V	V	V	V
Erodium cicutarium	.	.	.	.	.	.	.	.	.	.	V	.	V	V	.	.	.
Chenopodium album	.	.	.	.	.	.	.	.	.	.	.	V	.	.	.	.	.
Capsella bursa pastoris	.	.	.	.	.	.	.	.	.	.	.	V	.	.	.	.	.
Sonchus oleraceus	.	.	.	.	.	.	.	.	.	.	.	V	.	.	.	V	.
Crepis tectorum	.	.	.	.	.	.	.	.	.	.	.	V	V	.	.	.	.
Polygonum aviculare s.l.	.	.	.	.	.	.	.	.	.	.	.	V	V	.	.	V	.
Lycopsis arvensis	.	.	.	.	.	.	.	.	.	.	.	V	V	V	V	V	V
Tripleurospermum inodorum	.	.	.	.	.	.	.	.	.	.	.	V	V	V	V	V	V
Viola arvensis	.	.	.	.	.	.	.	.	.	.	.	V	V	V	V	V	V
Myosotis arvensis	.	.	.	.	.	.	.	.	.	.	.	V	V	V	V	V	V
Stellaria media	.	.	.	.	.	.	.	.	.	.	.	V	V	V	V	V	V

Centaurea cyanus	.	.	.	.	.	.	.	.	.	.	.	V	V	V	.	V	V
Papaver dubium	.	.	.	.	.	.	.	.	.	.	.	.	V	.	.	.	.
Mentha arvensis agrestis	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.	.	V
Arcticum tomentosum	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.	.	.
Digitaria ischaemum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.	.
Anthemis arvensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.	V
Polygonum tomentosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.
Agrostis stolonifera	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.
Geranium pusillum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	V
Scleranthus annuus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V
Vicia tetrasperma	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V

* The mark V designates the presence of species in the record.

Table 3. Transition zone from birch and aspen wood to field (forest island No. 7 — 0.5 ha)

Number of the record	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Environment of the record	forest's interior							forest's edge							field's edge		open field		
Cover of tree crowns (%)	40	40	30	40	40	50	50												
Number of vascular plants in the record	26	19	19	18	30	25	15	19	16	15	30	21	18	17	10	10	9	6	10
Forest species as follows below:																			
Ch. Vaccinio-Piceetea																			
Populus tremula	V*	V	V	V	V	V	V	V	V	V	V	V	V	V	.	.	.	.	.
Betula verrucosa	V	V	V	V	V	V	V	V	V	V	V	V	V	V	.	.	.	.	.
B. pubescens	V	V	.	.	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sorbus aucuparia	V	V	.	V	V	V	.	.	.	.	V	.	.	.	.	.	.	.	.
Juniperus communis	V	.	.	.	.	.	V	.	.	.	V	.	.	.	.	.	.	.	.
Vaccinium myrtillus	V	V	.	V	V	.	V	V	.	.	V	.	.	.	.	.	.	.	.
Pirola secunda	.	.	V	.	.	V	.	.	.	.	.	.	.	.	.	.	.	.	.
Solidago virga-aurea	.	.	V	V	V	V	.	.	.	.	V	.	V	.	.	.	.	.	.
Majanthemum bifolium	.	.	.	V	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mycelis muralis	.	.	.	.	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ch. Querco-Fagatea																			
Fraxinus excelsior	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Acer platanoides	V	.	.	V	.	V	.	V	.	.	.	.	.	.	.	.	.	.	.
Quercus robur	V	V	.	.	V	.	V	V	.	V	V	.	.	.	.	.	.	.	.
Ribes schlechtendalii	V	.	.	V	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Corylus avellana	.	.	.	.	.	.	.	V	.	.	.	.	.	.	.	.	.	.	.
Lonicea xylosteum	.	.	.	.	.	.	.	.	.	.	V	.	.	.	.	.	.	.	.
Padus avium	.	.	V	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Frangula alnus	V	V	V	V	V	V	.	.	V	V	V	.	.	.	.	.	.	.	.
Moehringia trinervia	.	.	.	V	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aceta spicata	.	.	.	.	V	V	.	.	.	.	.	.	.	.	.	.	.	.	.
Epilobium montanum	.	.	.	.	.	V	.	.	.	.	.	.	.	.	.	.	.	.	.
Other forest species																			
Pirus communis	.	V	.	.	V	.	.	V	.	.	V	.	V	.	.	.	.	.	.
Hieracium sp.	.	V	.	V	V	.	.	.	.	.	.	.	V	.	.	.	.	.	.
Equisetum silvaticum	.	.	.	.	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Geranium roberthianum	.	.	.	.	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Geum urbanum	.	.	.	.	.	V	.	.	.	.	.	.	.	.	.	.	.	.	.
Species of clearings and bruswoods																			
Ch. Epilobietea angustifolii																			
Viburnum opulus	V	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rubus idaeus	.	V	V	V	V	.	V	V	.	.	.	.	V	.	.	.	.	.	.
Salix caprea	.	V	.	.	.	.	V	V	.	.	.	V	.	V	.	.	.	.	.
Sambucus nigra	.	.	.	.	.	.	V	.	.	.	.	.	.	.	.	.	.	.	.
Fragaria vesca	V	V	.	.	V	V	V	.	.	.	V	.	.	.	.	.	.	.	.
Hieracium umbellatum	.	V	V	.	.	.	.	.	.	V	.	V	.	.	.	.	.	.	.
Calamagrostis epigeios	.	.	.	.	.	.	.	V	V	.	.	.	.	.	.	.	.	.	.
Galeopsis tetrahit	.	.	.	.	.	.	.	.	V	V	.	.	.	.	.	.	.	.	.
Ch. Rhamno-Prunetea																			
Cornus sanguinea	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhamnus cathartica	V	V	.	.	V	.	.	V	.	.	V	.	.	.	.	.	.	.	.
Crategus monogyna	V	V	.	.	V	V	V	V	.	.	V	.	.	.	.	.	.	.	.
Rosa sp.	.	.	.	.	.	.	.	V	.	.	V	.	.	.	.	.	.	.	.
Ch. Trifolio-Geranietea																			
Trifolium alpestre	.	.	V	.	.	.	.	.	.	.	.	.	V	.	.	.	.	.	.
Galium verum	.	.	.	.	.	.	.	.	.	.	V	.	.	.	.	.	.	.	.
Grasslands species																			
Ch. Molinio-Arrhenatherethea																			
Deschampsia caespitosa	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dactylis glomarata	V	V	V	V	V	V	.	V	V	V	V	V	V	V	.	.	.	.	.
Poa pratensis	.	.	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trifolium pratense	.	.	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Campanula patula	.	.	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Leucanthemum vulgare	.	.	V	.	.	V	.	.	.	.	.	.	.	.	.	.	.	.	.
Anthriscus silvestris	.	.	V	V	V	V	.	.	.	.	V	.	.	.	.	.	.	.	.
Knautia arvensis	.	.	V	.	.	.	V	.	.	.	.	.	.	V	.	.	.	.	.
Galium molugo	.	V	.	V	.	V	.	.	.	.	.	.	.	.	.	.	.	.	.
Taraxacum officinale	.	.	.	V	V	V	.	.	.	.	V	.	.	.	.	.	.	.	.
Festuca rubra	.	.	.	.	V	V	.	.	.	.	.	.	.	.	.	.	.	.	.
Agrostis vulgaris	.	.	.	.	.	.	.	V	V	.	.	.	.	.	.	.	.	.	.
A. alba ganthea	.	.	.	.	.	.	.	.	.	V	.	V	.	.	.	.	.	.	.
Achillea millefolium	.	.	.	.	.	.	.	.	.	.	V	V	.	V	.	.	.	.	.

Table 3, continued

No. of the record	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Senecio jacobea	·	·	·	·	·	·	·	·	·	·	·	V	·	·	·	·	·	·	·
Vicia cracca	·	·	·	·	·	·	·	·	·	·	·	V	·	·	·	·	·	·	·
Ch. Festuco-Brometea																			
Carlina vulgaris	V	·	V	·	·	·	V	·	·	·	·	·	V	·	·	·	·	·	·
Centaurea scabiosa	V	·	·	·	·	·	V	·	·	·	·	·	·	·	·	·	·	·	V
Poa compressa	·	·	V	·	·	·	·	·	·	V	·	·	V	·	·	·	·	·	·
Phleum pratense	·	·	·	·	·	·	·	·	·	V	·	·	·	·	·	·	·	·	·
Bromus inermis	·	·	·	·	·	·	·	·	·	V	·	·	V	·	·	·	·	·	·
Anthemis tinctoria	·	·	·	·	·	·	·	·	·	·	V	·	·	·	·	·	·	·	·
Ch. Sedo-Scleranthetea																			
Festuca ovina	·	V	·	V	V	V	V	·	·	·	·	·	·	·	·	·	·	·	·
Pimpinella saxifraga	·	·	V	·	·	·	·	·	·	·	V	V	·	V	·	·	·	·	·
Other grasslands species																			
Prunella vulgaris	·	·	V	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Trifolium campestre	·	·	V	·	·	·	V	·	·	·	·	·	·	·	·	·	·	·	·
Anthoxanthum odoratum	·	·	·	V	·	·	V	·	·	·	·	·	·	·	·	·	·	·	·
Allium sp.	·	·	·	·	V	V	·	·	·	·	·	·	·	·	·	·	·	·	·
Veronica chamaedrys	·	·	·	·	V	·	·	·	·	·	V	·	·	·	·	·	·	·	·
Hypericum perforatum	·	·	·	·	V	·	·	·	·	·	·	V	·	·	·	·	·	·	·
Tussilago farfara	·	·	·	·	·	·	·	·	·	·	·	·	·	V	·	·	·	·	·
Synanthropic species																			
Artemisia vulgaris	·	·	V	·	·	·	·	V	V	V	V	V	V	V	·	V	·	·	V
Melandrium album	·	·	·	·	·	·	·	V	V	·	·	V	·	V	·	·	·	·	·
Cirsium arvense	·	·	·	·	·	·	·	V	V	V	V	V	V	V	·	V	·	·	·
Agropyron repens	·	·	·	·	·	·	·	V	V	V	·	V	·	V	V	V	V	V	V
Equisetum arvense	·	·	·	·	·	·	·	·	V	·	·	·	·	·	·	·	·	V	V
Anthemis arvensis	·	·	·	·	·	·	·	·	V	·	·	·	·	·	·	·	·	·	·
Viola arvensis	·	·	·	·	·	·	·	·	V	·	V	·	·	·	·	·	·	·	·
Stellaria media	·	·	·	·	·	·	·	·	V	·	·	V	·	·	V	V	V	·	·
Polygonum convolvulus	·	·	·	·	·	·	·	·	V	·	·	V	·	·	V	V	V	·	V
Melilotus officinalis	·	·	·	·	·	·	·	·	·	V	·	·	·	·	·	·	·	·	·
Polygonum aviculare s.l.	·	·	·	·	·	·	·	·	·	V	·	·	·	·	V	·	·	·	V
Myosotis arvensis	·	·	·	·	·	·	·	·	·	·	V	·	·	·	V	·	·	·	·

Vicia villosa	.	.	.	.	.	.	.	.	.	.	V	.	.	.	V	.	.	.	.
Capsella bursa-pastoris	.	.	.	.	.	.	.	.	.	.	V	.	.	V	.	.	.	.	.
Tripleurospermum inodorum	.	.	.	.	.	.	.	.	.	.	V	.	.	V	V	V	V	.	V
Carex hirta	.	.	.	.	.	.	.	.	.	.	.	V	.	.	.	.	.	.	.
Sonchus arvensis	.	.	.	.	.	.	.	.	.	.	.	V	.	V	.	.	.	V	.
Convolvulus arvensis	.	.	.	.	.	.	.	.	.	.	.	.	V	.	.	.	.	.	.
Galium aparine	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.	.	.	.	.
Lapsana communis	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.	.	.	.	.
Raphanus raphanistrum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	V	V	.	V
Spergula arvensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	V	.	.
Centaurea cyanus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	V	.	V
Sinapis arvensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.
Chenopodium album	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.

island, and also some species of shrubs (*Crataegus monogyna*, *Rhamnus cathartica*, *Frangula alnus*, *Sambucus nigra*, *Rubus idaeus* and others). Raspberries represent an important component of both, the shrub layer of the woods and of the shrubbery belt on their edges. In places, they are scattered among other shrubs and in others — they form a shrubbery bank between the high-tree belt and the outer belt of grass and herbs.

The outer belt of the transition zone vegetation adjoining the field is most often composed of high grasses such as *Agropyron repens*, *Dactylis glomerata*, *Phleum pratense* ssp. *nodosum*, and of high herbs such as *Artemisia vulgaris*, less frequently *A. campestris*, *Achillea millefolium*, *Rumex acetosa*, *Peucedanum oreoselinum*, *Galium molugo* and others. In some places, particularly where the forest edge is composed exclusively of pines with branches reaching to the ground, and where the belt of shrubs is absent, the grassy belt consists of low grasses (*Festuca ovina*, *F. rubra*, *Agrostis canina* and others) and of low herbs, for instance *Fragraria vesca*. Sometimes medium-height herbs also occur. All this forms together a dense sod.

The forest-edge vegetation is to some extent differentiated according to the quarters of the compass, though those differences are usually not too large. Some differences were observed between northern and southern edges of birch and aspen woods with water pools in the middle and thus humid. On northern sides of those woods high herbs vegetation with the addition of humid-meadow species of the *Molinietalia* order develop. On the southern ones — species of fresh meadows of the *Arrhenatheretalia* order prevail, as well as those of the xerothermic ones of the Festuco-Brometea class. All this can be regarded as an evidence of differences in climatic and hydrological conditions. At the edges of the remnants of coniferous forests considerable differences are also noticeable: on their southern sides, low-grass community stretches from the edge of the field up to the area under tree crowns, and on their northern sides, mossy layer reaches far beyond the forest edge, sometimes extending over the ploughed borders of the field.

About 3 – 10 m wide belts of cultivated fields directly adjoining the forest edge differ to some degree from the remaining field. Usually they are much richer floristically. More species of field weeds grow there and sometimes also certain species from forest edges. The degree of weed infestation of those field belts is not always higher than that of the field itself, where few species develop.

4.4. ANTHROPOGENIC DEFORMATION OF FOREST-ISLAND VEGETATION

If the forest-island vegetation was not subject to human influence — past or present — it would always represent a mixed forest, an association in harmony with habitats occupied by those forest islands. But such is not the case. This vegetation has developed under the influence of human activity. Four of our islands are remnants of a planted pine forest that during about 80 – 100 years of its development has transformed into a mixed forest, in harmony with its habitat. The best evidence of the anthropogenic origin of those forests is the pine appearing as a dominant species in the high-tree layer. The other four of our islands represent birch and aspen woods, spontaneously grown in deforested and not cultivated places. In the process of natural succession they also become more and more similar to the mixed forest. Those woods are still far away from the final stage of succession. In their tree layer, still only pioneer species, birch and aspen occur. Pine and oak are absent. All those communities, of anthropogenic origin but developing spontaneously, are classified as semi-natural (Kornaś 1959, 1972, Faliński 1966, 1969).

How much the investigated forest islands differ from the final association to which they are gradually approaching in the process of their development, I tried to estimate on the basis of the still unfinished succession process and of the current anthropogenic transformations. The latter arise human agricultural activity or from its other forms, such as cutting trees, dumping refuse etc. All those processes bring about changes in the composition and structure of the vegetation.

The influence of human activity on plant communities of the studied forest islands manifests itself in various ways. For instance, cuttings bring about changes in the structure of vegetation within the islands and in ecological conditions. This, in turn, changes the composition and the floristic richness of the communities, for instance, through favoring photophilous species. Moreover, on such islands, synanthropic species appear, that is species developing in habitats modified by man. The vegetation of our islands is thus not identical with the natural vegetation of similar habitats. The question thus arises: are our islands fragments of a genuine forest? The answer is important, particularly from the point of view of protecting them from cutting and polluting.

To ascertain whether the investigated islands have still preserved the characteristics of the forest or have attained, in their development, the stage of a forest, I have estimated — on the basis of the Table 1 — the share of forest and non-forest species in their floristic composition. The results of those calculations, listed in Table 4, show a considerable share of forest species in the floristic composition of investigated remnants of mixed forest (forest islands No. 1, 2, 3). In the largest of them, this share is 63% and in the two next in size — above 50%. Only in a much devastated forest No. 4 (polluted, trampled and pastured) there is less forest species (below 40%). Nevertheless, their share in the floristic composition of this community is larger than that of any other group. In birch and aspen woods (forest islands 5—8) their share is smaller than in the mixed forests and is usually about 40%. Only in the largest one (No. 5), it approaches 50%. All this shows that on all islands, forest species represent the most numerous or one of two most numerous groups among the studied ones.

If the analysis of the share of forest and non-forest species is based on sums of cover indexes that show ecological value of species in plant communities, the predominance of forest species is much stronger (Table 5). It is determined chiefly by the cover of tree species forming the canopy of the forest.

The share of species from clearings and thictets is much smaller and oscillates between 16.7% and 22.7%. It is largest in a thinned out forest No. 2 and in the wood No. 5 where trees are dying in consequence of the changing water level in its

Table 4. The share of forest and non forest of vascular plants in forest islands vegetation on lake Jorzec in Masurian Lakeland (in numbers and percentage)

Number of forest island	1	2	3	4	5	6	7	8
Size of forest island in ha	35	13.5	1.0	1.0	1.5	0.5	0.5	0.125
Cover of tree crowns (%)	50	30	50	50	40	70	50	40
Number of vascular plant species in the record	54	53	53	66	53	52	74	52
Number of mosses species	6	4	4	3	2	2	1	2
Characteristic species of the associations classes (Ch.)								
Ch. Vaccinio-Piceetea	16	13	14	13	9	5	13	8
	29.6	24.5	26.5	19.7	17.0	9.5	17.6	15.4
Ch. Querco-Fagetea	13	12	10	7	12	11	14	11
	24.1	22.6	18.9	10.7	22.6	21.2	18.9	21.2
Other forest species	5	3	4	3	4	4	4	1
	9.3	5.7	7.5	4.5	7.5	7.5	7.5	1.9
Forest species jointly	34	28	28	23	25	20	31	20
	63.0	52.8	52.8	34.8	47.1	38.4	41.9	38.5
Ch. Epilobietea angustifolii	9	11	8	10	10	8	8	3
	16.7	20.8	15.1	15.2	18.9	15.4	10.8	5.8
Ch.Rhamno-Prunetea		1	3	2	2	1	3	3
		1.9	5.7	3.0	3.8	1.9	4.1	5.8
Ch. Trifolio-Geranietea							2	3
							2.7	5.8
Species of clearings and brushwoods jointly	9	12	11	12	12	9	13	9
	16.7	22.6	20.8	18.2	22.7	17.3	17.6	17.4
Ch. Molinio-Arrhenatheretea	3	4	5	10	6	11	14	10
	5.6	7.5	9.4	15.2	11.3	21.2	18.9	19.2
Ch. Festuco-Brometea			1	2	1	3	5	4
			1.9	3.0	1.9	5.6	6.2	7.7
Ch. Sedo-Scleranthetea	2	1	1	2		1	2	2
	3.7	1.9	1.9	3.0		1.9	2.7	3.8

Ch. Nardo-Callunetea	2 3.7	1 1.9	2 3.7	1 1.5			1 1.4	1 2.0
Other grasslands species	3 5.6	4 7.5	4 7.5	7 10.7	3 5.7	4 7.7	6 8.1	5 9.6
Grasslands species jointly	10 18.5	10 18.9	13 24.5	22 33.4	10 18.9	19 36.4	28 37.4	22 42.3
Synanthropic species	1 2.0	3 5.7	1 1.9	5 7.6	6 11.3	4 7.6	2 2.7	1 1.9
Planted species				4 5.7				

Table 5. The share of forest and non forest species in forest islands vegetation on lake Jorzec in Masurian Lakeland (in sums of cover indexes)

Number of forest island	1	2	3	4	5	6	7	8
Size of forest island in ha	35	13.5	1.0	1.0	1.5	0.5	0.5	0.125
Cover of tree crowns (%)	50	30	50	50	40	70	50	40
Number of vascular plants species in the record	54	53	53	66	53	52	74	52
Characteristic species of the associations classes (Ch.)								
Ch. Vaccinio-Piceetea	21900	15700	17200	177500	8300	11500	15500	17700
Ch. Querco-Fagetea	3800	8200	2850	5200	3700	2900	2200	2500
Other forest species	250	600	100	600	1150	100	150	50
Forest species jointly	25950	24500	21150	23550	12150	14500	17850	20250
Ch. Epilobietea angustifolii	1450	5400	5100	5300	3150	3200	4200	150
Ch. Rhamno-Prunetea		50	150	100	100	500	150	2800
Ch. Trifolio-Geranietea							100	150
Species of clearings and brushwoods jointly	1450	5450	5250	5400	3250	3700	4450	3100
Ch. Molinio-Arrhenatheretea	100	200	250	950	250	1000	700	5250
Ch. Festuco-Brometea			50	100	50	150	250	200
Ch. Sedo-Scleranthetea	50	500	50	100		50	1800	100
Ch. Nardo-Callunetea	100	50	100	500			50	50
Other grasslands species	100	650	200	350	550	3900	300	700
Grasslands species jointly	350	1400	650	2000	850	5100	3100	6300
Synanthropic species	50	150	50	2850	300	200	100	50
Planted species				1100				
Vascular plants species jointly	27800	31500	27100	34900	17550	23500	25500	29700

Table 6. The share of forest and non forest species in the vegetation of forest islands interior and on their edges (in numbers and percentage)

Number of forest island	1	2	3	4	5	6	7	8
Size of forest island in ha	35	13.5	1.0	1.0	1.5	0.5	0.5	0.125
Forest islands interior								
Cover of tree crovns (%)	50	30	50	50	40	70	50	40
Number of vascular plants species in the record	47	39	39	50	46	47	58	52
Forest species together	31	25	26	22	20	16	26	17
	66.0	65.8	66.7	42.3	43.5	34.0	44.9	32.6
Forest species without trees of high layer	29	24	25	20	18	15	25	17
	64.4	64.9	65.8	41.7	40.1	32.6	43.9	32.6
Species of clearings and brushwoods	8	10	9	9	9	8	10	8
	17.0	26.3	23.0	17.3	19.6	17.1	17.2	15.4
Species of meadows and dry grasslands	7	3	4	13	10	18	21	26
	15.0	8.0	10.3	23.1	21.7	38.3	36.1	50.0
Synanthropic and planted species	1	–	–	9	7	5	1	1
	2.2	–	–	17.3	15.2	10.6	1.7	2.0
Forest islands edges								
Number of vacsular plant species	30	39	36	42	57	43	58	40
Forest species	11	16	11	10	11	7	16	7
	36.7	41.0	30.6	23.8	19.3	16.2	27.6	17.5
Species of clearings and brushwoods	9	5	4	6	7	6	10	2
	30.0	12.8	11.1	14.3	12.3	14.0	17.2	5.0
Species of meadows and dry grasslands	7	11	14	18	24	21	14	19
	23.3	28.2	38.9	42.9	42.1	49.1	24.1	47.5
Synanthropic and planted species	3	7	7	8	15	9	18	12
	10.0	17.9	19.1	19.0	26.3	20.9	31.0	30.0

central depression. Species characteristic of grasslands (fresh and dry meadows etc.) are usually less frequent than the forest ones, particularly in larger fragments of mixed forest (No. 1 and 2) and in the largest birch and aspen wood No. 5. Only much devastated little forest No. 4 contains more of grassland species (33.4%). In birch and aspen woods — except the above mentioned No. 5 — the share of species from grasslands is larger. In the smallest wood (No. 8) it exceeds that of forest species (42.3% and 38.5%). Those numerous non-forest species in birch and aspen woods are remnants from previous, treeless stages of succession.

4.5. SHARE OF SYNANTHROPIC SPECIES IN THE FOREST-ISLAND VEGETATION

Synanthropic species are an element entirely alien to forest communities and to semi-natural meadow- and brushwood ones from which forest communities of small islands develop. The possibility that the range of those species could move from the field edge to the centre of a forest island depends on the quantity of field weeds and ruderal species that reach the forest community and on the resistance of the forest environment (Paczoski 1933). In our case, it depends on microclimatic, edafic and biotic conditions in the island's centre.

The quantity of synanthropic species seeds that attack our forest islands is relatively uniform since almost all of those islands are situated close together and are surrounded by similarly cultivated fields belonging to a large state farm. Only island No. 4, a bit more distant from all others, is surrounded by more weed-infested peasants' fields and is thus subject to a more intense attack of weed seeds. The result of the interplay of the above factors manifests itself in the share in its floristic composition of synanthropic species alien to the forest environment.

To determine the share of those species in the floristic composition of studied islands, I compared the phytosociological records made in the centres of those islands, on their edges, on field edges and in the centre of fields. As an example, I show here two such tables (No. 2 and 3) that refer to forest islands 3 and 7 (mixed forest of 1-ha surface and a birch and aspen wood of 0.5 ha). On the basis of 8 such tables, compounded for all investigated islands, I compiled a comprehensive table (No. 6) that represents the share of forest species and of three large ecological groups of non-forest species (clearing- and brushwoods species as well as those from grasslands and the synanthropic ones) in the centres of our islands and on their edges.

As far as the share of synanthropic species on the investigated islands is concerned, the Table 6 shows that in places where those investigations were carried out, they do not penetrate into the centre of three islands of mixed forest (No. 1–3). But they are frequent in the strongly devastated forest No. 4. As to birch and aspen woods (No. 7, 8), growing on an elevation, only 1–2 synanthropic species occurred. But they are present and relatively frequent in woods with a water pool in the centre (5 and 6).

Together, on all eight investigated islands I found 10 synanthropic species, concentrated mainly on islands 4, 5 and 6. They are predominantly apophytes, synanthropic plants of indigenous origin. They are indicative of some disturbances in the plant cover and in the habitat. I found only three anthropophytes, that is species that owe their existence exclusively to the human activity: one archeophyte (*Viola arvensis*) and two kenophytes (*Impatiens parviflora* and *Rudbeckia laciniata*) (K o r n a ś 1959, 1968, 1972, E.U. Z a j ą c and A. Z a j ą c 1975). The two latter species indicate a strong synanthropization of the plant association. I found the first in the mixed forest No. 4 (the most devastated) and the second — in humid depressions of forest No. 2 where liquid dung was dumped. Apart from those, I found 5 man-planted species, all in forest No. 4.

On the edges of investigated islands, synanthropic species are of course much more frequent than in their centres, both from the point of view of their number and the percent of their share in the floristic composition. It should be stressed here that the number of synanthropic species in the inner part of the island does not depend on their number on its border but on the human interference in the island's interior. Birch and aspen woods No. 7 and 8 on whose edges a large number of synanthropic species was found are almost free of them in their centres. Another fact appears to be important here, namely that in the ecotone zone, synanthropic species appear in masses close to the edge of the field, that is in the belt which is every now and then disturbed by ploughing. They are much less frequent in the grassy belt adjoining the forest. This observation is in accordance with the results of K o r n a ś and M e d w e c k a - K o r n a ś (1968) investigations. They discovered a strong resistance of natural and semi-natural associations with a dense vegetation to the invasion of synanthropic species. On the contrary, open anthropogenic communities are easily invaded by them.

4.6. ANALYSIS OF FACTORS THAT DETERMINE THE DEGREE OF DEFORMATION OF FOREST-ISLAND VEGETATION FROM THE POTENTIAL NATURAL ASSOCIATIONS

1. The origin of forest islands is an important factor in their differentiation. Remnants of mixed forests (islands 1, 2 and 3) have the greatest number of forest species. The second place in their floristic composition is occupied by species from clearings and brushwoods, that is by those in some way connected with the forest. Their combined share amounts to about 80%. Species from grasslands are few and the synanthropic ones are almost absent. Only island No. 4 contraste with them since for a long time it was subject to a strong and varied anthropopressure.

Birch and aspen woods, spontaneously grown in deforested but not cultivated areas, are still in various stages of succession and have not yet reached the final stage of mixed forest. Thus, we have here to do with a developing forest association overlapping a retreating grassland community. No wonder that grassland species are relatively frequent and the forest ones less numerous than in remnants of mixed forest. Consequently, remnants of large forests that developed from artificially planted ones are much more similar to the final associations of their habitat than birch and aspen woods that developed from clearings.

2. The dependence of the floristic composition of a forest island on its size is a problem — complicated and difficult to understand on the sole basis of data compiled in this report. Our investigations have demonstrated that as far as the group of fragments of mixed forest and the group of birch and aspen woods is concerned, a larger (by about 10%) share of forest species than in other islands was found only in the flora of the biggest islands within their group (Table 4, No. 1 and 5). But the number and particularly the percentage of grassland species grows with the decrease of island's size. I analysed this interdependence separately for two pairs of woods: the first two woods were depressed in the centre and humid — and the second — elevated in the centre and dry. The result was similar: in larger islands forest species were more frequent and the grassland ones rather sparce.

On the other hand, the richness of species on the islands of the investigated size is apparently independent of it. On the majority of investigated islands I found an almost identical number of species (52–54). A higher number of species (66) in the vegetation of a 1-ha island subject to a strong anthropopressure can be explained by changes brought about by human activity (such as a larger number of synanthropic species and the presence of the planted ones). More difficult to explain is the presence of an even greater number of species in the vegetation of the larger of the two birch and aspen woods, elevated in their centre and dry. Maybe, what requires explanation is the lesser number of species (74 and 52) in the vegetation of the smaller island, growing in similar conditions. Maybe that in choosing for our investigations a very small island (0.125 ha) we crossed a threshold of the island's size below which a forest plant community cannot develop. This problem should be given further investigations.

3. The situation of forest islands in relation to earth relief and the resulting presence of water variously influences their floristic composition. Table 2 and 6 both show that birch and aspen woods growing on elevations and thus dryer are floristically richer than those with depressions in their centre and thus humid. Moreover, in the vegetation of dry woods, species characteristic of dry grasslands and forest edges of the classes Festuco-Brometea, Sedo-Scleranthetea and Rhamno-Prunetea are more frequent. In depressed and thus humid woods, species more exacting as to humidity of soil appear. Synanthropic species are also more frequent there.

4. The distance from sources of pollution is an important factor determining the degree of synanthropization of forest islands. This fact is obvious from the floristic composition of the island No. 4, located near a village, at a little distance from nearest buildings (0.5 km only). This island differs very distinctly from all other mixed forests and — more important — it strongly differs from the island No. 3, notwithstanding its similar origin and size. The pressure of anthropogenic factors on the island No. 4 is considerable. Surrounding peasants' fields are greatly infested with weeds. The island has some additional sources of contamination with alien species since this wood is crossed by a accessible to vehicles and this way refuse and various waste is brought into the wood. All this changes the chemistry of soil. In this way, also seeds of plants alien to the forest community are brought to the area.

Besides, in the centre of the forest an old grave is situated and around it several garden species of shrubs and herbs were planted. They have run wild and spread over the surrounding forest.

We should also pay some attention to the fact that at the edge of the field, close to the strongly weed-infested humid wood No. 5, surplus cow dung and straw used to be deposited. Along with water flowing from under it, some seeds with germination power could have penetrated into this wood and into the wood No. 6 — also depressed in the centre.

5. SPECIFICATION AND DISCUSSION OF RESULTS

Studies of the forest-island vegetation in the vicinity of lake Jorzec (in the Masurian Lakeland, north-eastern Poland) resulted in the following conclusions:

1. On the investigated area, the remnants of forest and small, spontaneously grown forest islands represent semi-natural communities. The nearest natural forest communities developing in the same habitats can be found in a complex of forests of the Strzałowo inspectorate, south-west of the investigated region.

2. Small remnants of forests (1–35 ha) represent communities of a mixed forest character (Pino-Quercetum Kozł. 1925 em. Mat. et Polak 1955). They developed during some 100 years from planted pine forests. Small birch and aspen woods (0.125–1.5 ha) represent succession stages, from treeless communities to a mixed forest, that is to the same community, consistent with the habitat.

3. In the floristic composition of the mixed-forest vegetation, forest species strongly predominate over species of such terrains as meadows, dry grasslands etc. In birch and aspen woods the share of the latter is near that of forest species or even higher (the smallest island = 0.125 ha).

4. The floristic richness of the majority of studied islands (0.125–35 ha) is more or less the same (52–54 species). It is thus difficult to detect its dependence on the island's size — within, at least, the investigated range. A much greater floristic richness of mixed-forest island No. 4 (66 species) can be explained by a considerable share of synanthropic species and the presence of those planted by man. The greatest floristic richness of all was found in the larger of the two dry birch and aspen woods (74 species on the surface of 0.5 ha) This wood, developed in the habitat exceptionally suitable for a floristically rich mixed forest still contains many species of clearings and meadows from earlier stages of succession. A smaller wood, developing in similar conditions, would probably be too small to provide development conditions for such number of species. But as to the number of species itself, it is not lesser than on larger surface of mixed forest, where meadow and grassland species are less frequent and the forest ones prevail.

5. On the majority of studies islands the share of synanthropic species is insignificant. It is distinctly marked only in the vegetation of islands 4, 5 and 6. Those islands are more than all other subject to the influence of human activity and this influence affects even their centres.

6. Resistance of the studies islands against infestation with synanthropic species is particularly worth of notice since the agriculturally exploited region around lake Jorzec abounds in them. One could expect that the habitat of a small forest island is not suitable for photo- and nitrophilous plants of cultivated fields. But the example of island 4, with a relatively dense canopy (cover = 40–60%) and where the invasion of synanthropic species comes not only from outside (through a transition zone and the forest wall) but also from inside, shows that the success of the invasion depends mainly on by-passing the barrier of the transition zone.

7. In the transition zone from fields to forest, weed species appear chiefly on the field side, in the outer belt of grasses, often distrubed by ploughing. Among shrubs of the forest edge they are less frequent and under low branches of trees of the forest edge they are absent. It could be assumed that the dense wall of trees, with branches reaching all the way to the ground, effectively protects forest islands against penetration of weed seeds into their centre and the dense sod of the outer belt prevents seeds from germinating in the immediate vicinity of the forest. Grassy sod on the edges of mixed or coniferous forests forms a much more dense carpet then the herbs on the edges of the deciduous ones.

8. Forest islands depressed in their centre (No. 5, 6) are subject to occasional floodings from cultivated fields. The water brings surpluses of biogenes (particularly of nitrogen) and thus changes the soil chemistry. Those islands are less resistant to invasion of nitrophilous synanthropic species than those elevated in the middle (No. 3, 7, 8) or situated on a slope (No. 1).

Investigations of other authors concerning forest islands were conducted somewhat differently from ours. Their aims were different and thus the method of their realization was also different. Moreover, a different geographical situation of studied areas resulted in different ecological conditions. For instance, studies of Levenson (1981) on Lake Michigan were — to all appearances — carried in conditions similar to ours (a post-glacial region with great lakes) but de facto their area was situated by 10° of geografical latitude more to the south and the climate considerably warmer. The flora of Lake Michigan surroundings was — contrary to our own — not destroyed by glaciation and is thus much richer, particularly in tree species. The area was deforested and agriculturally cultivated much later then ours. That is why, Levenson chose for his study islands with original or at least natural vegetation. Working in a region with a much richer flora, richer particularly in tree species, he was able to limit his studies to trees and shrubs only.

Despite those differences, some results of his investigations are consistent with ours. He noticed the dependence of the floristic richness of forest islands not only on their size but primarily on the variety of habitat conditions (to some extent connected with that size) and on the degree of the disturbance of the forest communities. Similar investigations on the herb layer of forests were conducted by Hoehne (1981), with results similar to those of Levenson.

Levenson was interested in the size of the forest island that allows the development of a forest community of a particular type, distinctly different from that of the forest edge (ecotone). From his studies and some considerations he draws a conclusion that in the vicinity of Lake Michigan a forest island of not less than 2.3 ha would be needed. Nevertheless, he quotes some other american authors who worked at the same geographical latitude and who found lower values of the minimum surface of forest islands (1.6 and 2.0 ha).

Results of our investigations of anthropogenically formed forest islands suggest that all remnants of planted forests that during 100 years of their existence have already acquired many characteristics of a natural one can be classified as definite types of forest communities, irrespective of their size. I have in mind both, large forest islands (35 and 13.5 ha) and small ones (1 ha). The investigated birch and aspen woods composed of pioneer tree species represent as yet succession stages on the way to the same final community that remnants of planted forests have already reached. Their species composition is not yet identical with that of a forest community (only 40% of forest species) but the sum of cover indexes of forest species, particularly of tree crowns, is considerable and determines the forest-like physiognomy of the community.

All this suggests that in the actual conditions of our study, the minimum size of the forest island that allows the development of the forest community is probably as small as 1 ha or even 0.5 ha and thus less than surfaces referred to by Levenson on the basis of this own and other american authors' investigations. Levenson is of the opinion that those forest islands (above 2.3 ha) deserve protection in whose interior a forest habitat typical for the region develops. They are not necessarily richest from the floristical point of view. Only the shadow tolerating species grow there. In Levenson's opinion, the greatest floristic richness that characterizes transition-zone communities and anthropogenically transformed islands should not be the prerequisite nor even a most important condition for choosing a particular island for protection. According to his view, it is necessary to protect both — larger forest islands, non disturbed by man, where regional types of forests subsist, and the small ones, rich in species, which preserve the floristic richness of the region.

Scientific papers concerned with forest islands and other midfield woods within the agricultural landscape in Poland are of two kinds. Studies of the first category cover midfield hedgerows along roads, brooks and small game preserves (that is, artificial woods or those spontaneously grown in habitats strongly disturbed by man or not siutable for cultivation). Those investigations were concerned with the influence of those hedgerows on the ecological conditions of surrounding fields and on the resulting crops of cultivated plants. Primarly, those studies were concerned with the influence of those hedgerows on the climate and, above all, with teir value as wind screens, with changes in water conditions in the soil of surrounding fields, with their role in soil conservation and pest control.

Polish literature on the subject comes mainly from the southern Great Poland (Wielkopolska, middle-western part of the country) and from the period of late forties to the mid-sixties (for instance, Foksowicz and Sokołowski 1956, Wilusz 1958, Kamiński 1967, Gromadzki 1970, Jakubczyk 1973).

An entirely different type of research initiated much later is connected with nature protection and, more precisely, with protection of genetic resources. Those studies are concerned with conditions of survival of rare species, particularly the forest ones, in the remnants of forests within the agricultural landscape. Such studies were conducted in the remnants of natural forests of the subcontinental deciduous forest (Tilio-Carpinetum Traczyk 1962), that is, in a habitat more fertile than that of our studies.

In the oldest study of this category (F a l i ń s k i 1976) from the Bielsk Upland (north-eastern Poland), this problem was studied on as many as 105 small islands of a natural subcontinental deciduous forest, in its sub-boreal race. They represent very small remnants of an old forest (a few m^2 to several dozen m^2), scattered over 50 ha of cultivated fields.

After nine years from the first observations, considerable changes occurred as a result of ploughing, duming stones, felling trees and pollution of the islands. They were followed by changes in the floristic composition and in the vertical structure of those forest tree clusters. Many trees survived only in the form of suckers. Some species died out. The number of species from edges and brushwoods increased. Forest species of herbs, even perennial ones, diminished in number. Some of the clusters disappeared. In larger ones, forest species survived for a longer time. On steep slopes and other places untouched by agriculture, the forest islands as such and with them some forest species survived for a longer time.

Later studies by D z w o n k o and L o s t e r (1988a, 1988b, 1989), carried out in West-Carpathian Foothills, concentrated on forest species growing on small islands (40 – 200 m^2). The following results of those studies can be considered as most important:

The number of species depends on the diversity of habitats and this, in turn, depends to some extent on the island's size. This confirms somehow the results of L e v e n s o n' s studies (1981). That number also depends on the island's shape and its degree of isolation, as well as on the tree and shrub cover. The number of forest and non-forest species, particularly those of the Querco-Fagetea and Molinio-Arrhenatheretea class, and of the species with various modes of dispersal, including anemochoric trees, able to colonize new habitats, depends on the lenght of time from the island's isolation and on anthropogenic deformations. Another important result of those studies is the ascertainment that individual old remnants of forests contain, on the average, less species than would a combination of several small islands of the same combined size. The probability of survival of rare species within the islands is the greater, the greater is the sum total of all species. Small islands represent refuges of forest species and that is why they are particularly worthy of protection. Those results, supported by a detailed statistical analysis, confirm those of the earlier analyses (F a l i ń s k i 1976).

Our studies were made in the communities of poorer habitats (Pino-Quercetum) and they concern forest communities developed from forests planted by man or from woods spontaneously grown in places with the vegetation destroyed by man. In the process of natural succession, they change from pine monocultures and clearing communities into forest communities and they acquire more forest species. At the same time, they change under the influence of anthropogenic factors.

Moreover, the ultimate end of our studies is somewhat different. On the islands investigated by F a l i ń s k i (1969) and by D z w o n k o and L o s t e r (1988a), the direction of changes is different — they impoverish the species composition of the phytocoenoses and thus result in the loss of forest species connected with the original community. F a l i ń s k i (1976) studies the durability of very small forest remnants in the agricultural landscape, that is of forest phytocoenoses and of individual forest species. D z w o n k o and L o s t e r (1989) concentrate on the number and distribution of species within forest islands with various habitat conditions.

The object of our particular interest is the ecological and — primarily — the biocoenotical value of forest islands in the agricultural landscape, their mutual influences resulting from their distribution with respect to the earth relief and their mutual distances and, finally, their changes over time. Besides, those botanical studies are closely connected with the zooecological ones and can be regarded as some kind of basis for them.

6. SUMMARY

Studies of the forest-island vegetation were carried out in the agricultural landscape around lake Jorzec in the Masurian Lakeland. Eight forest islands of various size (0.125 – 35.0 ha) were investigated. Four of them, the larger ones, consisted of planted pine forest (about 80 – 100 years old) and the remaining four — of birch and aspen woods, spontaneously grown in deforested but not cultivated places. Those islands were chosen as representative of the agriculturally exploited parts of the Masurian Lakeland.

This report, the first of the volume concerned with the ecological value of forest islands, contains a geographical and geobotanical characterization of the investigated area. The characterization of the vegetation is divided in three parts: a general characterization of forest islands, a characterization of remnants of planted forests and spontaneously grown woods and, finally, that of individual forest islands.

Our study includes floristic investigations of whole islands or 1-ha surfaces of the largest ones (Table 1), as well as phytosociological records on transects from the middle of the forest to that of the field (Tables 2, 3). On the basis of tabulated results, we analysed the dependence of the floristic composition of forest islands on their origin, size, relief and distance from pollution sources. From this, the following conclusions were drawn:

1. Neither the remnants of planted forests nor of spontaneously grown deciduous woods represent natural communities — they are only semi-natural.

2. Small remnants of forests (1 – 35 ha) represent forest communities of a mixed forest type (Pino-Quercetum Kozł. 1925 em. Mat. et Polak. 1955). They developed from planted pine forests during some 100 years. Small birch and aspen woods (0.125 – 1.5 ha) represent succession stages from communities grown in new clearings to final communities of mixed forest.

3. In the floristic composition of the mixed-forest vegetation (Tables 4, 5), forest species strongly prevail over those of meadows, dry grasslands etc. In birch and aspen woods, the share of latter species is similar to that of the forest ones or even larger (the smallest islands = 0.125 ha).

4. Within our investigated range of magnitude (0.125 – 35 ha), the size of the island does not significantly influence the floristic richness of plant communities (Table 2). The majority of islands (3 mixed forests and 3 birch and aspen woods) contain a similar number of species (52 – 54). A larger number of species (66) characterizes one of the two mixed forests of 1-ha surface, subject to a strong anthropopressure that changes its floristic composition. Synanthropic species are more numerous and some planted ones are also present. The greatest floristic richness (74 species) is found in a very small

birch and aspen wood (0.5 ha), grown on an elevation and thus dry. It has therefore suitable conditions for the development of a mixed forest, rich in species. But many species characteristic of open spaces, clearings and brushwoods, are also frequent there. The smallest island (0.125 ha) is too small for such richness of species to have developed.

5. The share of synanthropic species in the majority of studied islands is insignificant. Only three islands (4, 5 and 6), those more subject to human activity than the rest of them, have more of those species (Tables 4–6), particularly as this human activity has penetrated into their very centres.

6. Worthy of notice is the resistance of studied islands against infestation with synanthropic species which are plentiful in this agriculturally exploited region. One could almost conclude that the forest habitat of an even small island is not suitable for photophylous and nitrophylous plants of cultivated fields. However, the example of island 4, with its rather dense crown cover (40–60), subject to the synanthropic species invasion not only from outside (through the transition zone and the forest wall) but from inside — indicates that the by-passing of the transition-zone barrier is a determining factor that makes for the success of the invasion. Similar is the case of island 5, now and then flooded by waters from under heaps of cow dung and straw stored close to it. Those waters could bring weed seeds to the depressed island's centre and thus change soil chemistry into one more suitable for synanthropic species.

7. In the transition zone from field to forest, weed species appear primarily on the field's edge and in the outer grassy belt on the field's side, often disturbed by ploughing. Among shrubs in the central belt of the transition zone, they are scarce and under low branches of peripheral trees forming the forest wall they do not appear at all. We may assume that the dense wall of trees with branches reaching from the ground to their tops — effectively protects the interior of forest islands against weed seeds carried by wind. Similarly, the compact grassy sod of the outer belt of the transition zone prevents seeds from germinating in the immediate vicinity of the forest. The grassy sod on the edge of mixed and coniferous forests forms a carpet much more compact than the herb on the edges of deciduous forests.

8. Forest islands depressed in the middle (No. 5 and 6) are subject to flooding by waters from surrounding cultivated fields. Those waters carry excess of nutritional components, particularly of nitrogen, and thus change the chemistry of forest soil. Those islands are therefore less resistent to invasion of nitrophilous synanthropic species than those elevated in their centre (No. 3, 7, 8) or those situated on a slope (No. 1).

7. POLISH SUMMARY

Badania nad roślinnością wysp leśnych prowadzono w krajobrazie rolniczym otoczenia Jez. Jorzec na Pojezierzu Mazurskim. Zbadano 8 wysp leśnych różnej wielkości (0,125–35,0 ha). Cztery z nich, na ogół większe, reprezentowały sadzone lasy sosnowe (około 80–100 lat), cztery pozostałe — zagajniki brzozowo-osikowe wyrosłe spontanicznie na miejscach odlesionych i nie objętych uprawą. Wyspy te wybrano jako reprezentatywne dla zagospodarowanych rolniczo części Pojezierza Mazurskiego.

Praca ta jako pierwsza w zeszycie poświęconym znaczeniu ekologicznemu wysp leśnych zawiera charakterystykę geograficzną i geobotaniczną obszaru badań. Charakterystyka badanych wysp leśnych ujęta jest w trzech stopniach: ogólna charakterystyka wysp leśnych, charakterystyka pozostałości lasów sadzonych i spontanicznie wyrosłych zagajników oraz charakterystyka poszczególnych wysp leśnych.

Badania obejmowały poszukiwania florystyczne na powierzchni całych wysp lub na 1 ha powierzchniach wysp największych (tab. 1) oraz zdjęcia fitosocjologiczne na transektach od wnętrza lasu do środka pola (tab. 2, 3). Na podstawie ujętych w tabele wyników badań przeprowadzono analizę zależności składu florystycznego wysp od ich pochodzenia, wielkości, reliefu i odległości od źródeł zanieczyszczeń. Na tej podstawie wysunięto następujące wnioski:

1. Ani pozostałości lasów sadzonych, ani spontanicznie wyrosłe zagajniki liściaste nie są zbiorowiskami naturalnymi, lecz tylko seminaturalnymi.

2. Nieduże pozostałości lasów (1–35 ha) są zbiorowiskami leśnymi o charakterze borów mieszanych (Pino-Quercetum Kozł. 1925 em. Mat. et Polak 1955). Rozwinęły się one w ciągu około 100 lat zgodnie

z typem siedliska z zasadzonych lasów sosnowych. Małe zagajniki brzozowo-osikowe (0,125–1,5 ha) są stadiami sukcesji od zbiorowisk zrębowych po wycięciu lasu do boru mieszanego.

3. W składzie florystycznym roślinności (tab. 4, 5) borów mieszanych przewaga gatunków leśnych nad gatunkami miejsc otwartych, jak łąki, suche murawy itp., jest znaczna. W zagajnikach brzozowo-osikowych udział gatunków miejsc otwartych jest bliski udziałowi gatunków leśnych lub nawet go przewyższa (najmniejsza wyspa 0,125 ha powierzchni).

4. Wielkość wyspy w badanym przez nas zakresie (0,125–35 ha) nie wpływa w sposób znaczący na bogactwo florystyczne zbiorowisk roślinnych (tab. 2). Większość wysp (3 bory mieszane i 3 zagajniki brzozowo-osikowe) ma podobną liczbę gatunków (52–54). Większą liczbą gatunków (66) odznacza się jeden z dwu 1 ha borów mieszanych, który podlega silnej antropopresji zmieniającej jego skład florystyczny (m.in. przybywa gatunków synantropijnych i obecne są gatunki posadzone). Największe bogactwo florystyczne (74 gatunki) cechuje bardzo mały zagajnik brzozowo-osikowy (0,5 ha), znajdujący się na wzniesieniu i w związku z tym suchy. Są tam zatem dobre warunki dla rozwoju bogatego w gatunki boru mieszanego, a jest tam jeszcze dużo gatunków miejsc otwartych oraz zrębów i zarośli. Najmniejsza wyspa (0,125 ha) jest już na to bogactwo gatunkowe zbyt mała.

5. Udział gatunków synantropijnych w większości badanych wysp jest mały. Tylko trzy wyspy (nr 4–6), bardziej niż inne poddane wpływom działalności człowieka i to sięgającym do ich wnętrza, mają tych gatunków więcej (tab. 4–6).

6. Odporność badanych wysp leśnych na zachwaszczenie gatunkami synantropijnymi, których w zagospodarowanym rolniczo obszarze jest dużo, godna jest uwagi. Można by sądzić, że środowisko leśne nawet małej wyspy leśnej nie jest odpowiednie dla światłolubnych i azotolubnych roślin z pól uprawnych. Jednakże przypadek wyspy nr 4 o stosunkowo dużym zwarciu koron (40–60), na którą inwazja synantropijnych roślin idzie nie tylko z zewnątrz przez strefę przejścia i ścianę lasu, ale i od wnętrza, wskazuje na to, że czynnikiem decydującym o powodzeniu inwazji może być ominięcie bariery, jaką stanowi strefa przejścia. Podobnie jest z wyspą nr 5, przy której składowano obornik i słomę; spływające spod nich wody mogą dostarczać nasion chwastów do wnętrza wyspy obniżonej w środku i zmieniać chemizm gleby w kierunku korzystnym dla synantropów.

7. W strefie przejścia od pola do lasu gatunki chwastów występują przede wszystkim na skraju pola i w zewnętrznym pasie trawiastym od strony pola, często naruszanym przy orce. Wśród krzewów w środkowym pasie strefy przejścia jest ich już mało, a pod nisko schodzącymi gałęziami skrajnych drzew, które tworzą ścianę lasu, nie ma ich już zupełnie. Można przypuszczać, że zwarta ściana drzew ugałęzionych od samej ziemi po wierzchołki skutecznie chroni wyspy leśne przed przywiewaniem nasion chwastów do ich wnętrza, a zwarta darń trawiasta zewnętrznego pasa strefy przejścia nie dopuszcza nasion do kiełkowania w bezpośredniej bliskości lasu. Darń trawiasta na skrajach borów mieszanych i szpilkowych tworzy kobierzec znacznie bardziej zwarty niż ziołorośla na skrajach lasów liściastych.

8. Wyspy leśne obniżone w środku (nr 5, 6) są narażone na spływy wód z otaczających je pól uprawnych, które niosą nadmiar składników pokarmowych, zwłaszcza azotowych i przez to zmieniają chemizm gleby leśnej. Są one zatem mniej odporne na inwazję azotolubnych gatunków synantropijnych niż wyspy w środku wyniesione (nr 3, 7, 8) lub znajdujące się na długim stoku (nr 1).

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