ADATOK AZ ERDŐ MADÁRPOPULÁCIÓJÁNAK FUNKCIÓJÁHOZ A BIOCÖNOLÓGIA ÉS ERDŐGAZDASÁG SZEMPONTJÁBÓL

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ÖSSZEFOGLALÁS

1. Minden erdőtípust egy sajátságos madárpopuláció, ennek a típusnak madártársulása jellemez. E madárpopuláció kvantitatív és kvalitatív összetétele az erdőtípus közvetlen kifejezése, illetve ezen erdőtípuson belül uralkodó életkörülmények kifejezése.

2. Az erdő (típus) madárpopulációja nem osztódik el egyenletesen a területen és térben, hanem mind a madár, mind az egyéb állat- és növénypopulációk szétszórtan, foltokban, csoportokban fordulnak elő. Ennek következtében a használatos kifejezés, mely a populációk (fajok, egyedek) sűrűségét 100 hektár, acre stb. területen adja meg, általánosításnak tekinthető, mely relatív értékkel bír. A szerző véleménye szerint kisebb és kis területek tanulmányozása lesz fontos — tekintettel a csoportokban való előfordulásra — egy erdőtípus mindennemű populáció-sűrűségének kifejezéséhez.

3. A szlovákiai lomblevelű erdőtípusok madárpopulációjának sűrűsége 0,5 és 30 madár közt váltakozik hektáronként. A szerző indítványozza mind a sűrűséget, mind a dominanciát biomasszában kifejezni (súlyegység).

4. Egy erdőtípus madárpopulációja több szempontból osztályozható, úgymint táplálék, vertikális és horizontális osztódás (stratigrafia), szisztematikai affinitás stb. szerint. Biocönológiai szempontból a madárpopuláció funkciók szerinti osztályozása célhoz vezető, természetes és dinamikus. Ezért az ilyen osztályozásnál nem a madarat mint egyedet, fajt, tehát nem a madarat magát, hanem a funkcióját — melyet az életközösségen belül tölt be — vesszük figyelembe. Így történik azután, hogy egy és ugyanazon madár (egyed, rassz, faj stb.) többféle funkcióban tényked hetik.

A madárpopuláció mint egész, valamint a madárpopuláció tagjainak funkciója a következő: konstruktív funkció (pl. a magvak terjesztése, a talaj kultiválása, megmunkálása, a növénykártevők pusztítása stb.) és destruktív funkció (pl. a magvak fogyasztása, a beteg, nem vitális, nem ellenálló állati és növényi egyedek — mint a közösség tagjai — elhalásának gyorsítása, lehetővé tétele és mineralizációja, a társulás — idegen állati és növényi egyedek, csoportok kiszorítása, a növényi test mineralizációjának meggyorsítása, az ú. n. hasznos formák fogyasztása stb.). E két funkciócsoport mint két antitézis szerepel a társuláson belül, melynek szintézise a biocönozis (életközösség) fenntartásában nyilvánul meg, illetve a madárpopuláció részleges hozzájárulásában az életközösség fenntartásához.

5. Egy erdőtípus (*Szukachew* koncepciója szerint), tekintve a madárpopuláció funkcióját, az erdőben két szempontból vizsgálhatjuk: biocönológiai és erdőgazdasági, vagy ökonomikai szempontból. Ha helyes képet akarunk

alkotni a madárpopuláció szerepéről ökonomikai szempontból, akkor a biocönológiai szempont tanulmányozása, kivizsgálása kell, hogy alapul szolgáljon.

6. Az erdő életközösségében nincsen hasznos, káros vagy éppen közömbös madár, hanem van hasznos és káros tevékenység, melyet — térben és időben határolva — egy és ugyanazon madár gyakorolhat. Az összes funkció hozzájárul az erdő (ennek életközösségének) fenntartásához, valamint dinamikus, váltakozó quasi egyensúlyi állapot fenntartásához. A madárpopuláció ilyen meglátását csak a metafizikai élettelen koncepció teljes elvonása teszi lehetővé.

7. Erdőgazdasági szempontból az erdő madárpopulációja (melybe az összes, az erdőben táplálkozó madár sorolandó) nagy fontossággal bír. Ilyen főbb szempontok : terjeszti a magvakat ; a társulás sok tagjának léte, terjedése éppen a madárpopulációtól függ, amint ezt a tölgy és sok cserje esetében kimutatom a jelen munkámban ; pusztítja a növények kártevőit, ellenben nem képes egy már kitört kártevő-túlszaporodást (pl. rovarjárás) likvidálni, amennyiben a túlszaporodott kártevő mint táplálék a madárpopuláció kapacitásán felül, míg a madárpopuláció szaporodási potenciája a kártevőén alul marad ; a madárpopuláció a növényi és állati testek (anyagok) fontos konvektora hozzájárul ezek mineralizációjához ; a talaj felületét a lehullott lombréteg megbontásával előkészíti a magvak befogadására ; a madárpopuláció pusztítja a kisemlősöket, főleg a rágcsálókat, melyek az erdő megújulásának gyakori akadályát képezhetik ; a madárpopuláció állandóan fékentartja a nem fluktuáló és nem tömegesen fellépő kártevők (ízeltlábúak) populációját, és ezzel csökkenti a komplex-kártevést ; a madárpopuláció meghosszabbítja az egyes rovarjárások közti időszakot azzal, hogy fékezi a populáció felépülését, mint ezt a gyapjaspille esetében lehet tapasztalni. Végül a madárpopuláció különös szerepe a társulás (esetünkben az erdőtípus) fenntartása minőségi és mennyiségi összetétel szempontjából — idegen elemek kiszorítása, legyen az állati vagy növényi komponens.

8. A másodlagos, gazdaságilag kezelt erdők az ökonomikai madártan szempontjából a következő rendszabályokat kívánnák meg :

áttérni az elegyes erdőtípusokhoz az eddigi gyakori monokultúrák helyett, mely utóbbiak nem telített társulások, madárpopulációjuk alacsony és ellenállóképességük mind a kártevőkkel, mind az elemi csapásokkal szemben elégtelen ; az erdőhasználatban elhagyni a tarvágást és hasonló módszereket, melyek drasztikus és mély beavatkozást jelentenek az életközösségbe ;

az erdővédelmet az erdőnevelésre építeni az említett elegyes állományok tekintetbevételével ;

az állomány összetétele, keverése. Ennek módjának és fokának kiválasztását alapos biocönológiai kutatás előzze meg, melyben a madárpopuláció fontos útmutatást nyújthat az állomány összetételére, keverésére, az elemek társulásbeli hovatartozandósága tekintetében ;

a már létező és kártevők által fenyegetett monokultúrákban, elegyetlen állományú erdőtípusokban a madárpopuláció mesterséges úton gyarapítható, mégpedig védelem, téli etetés, odvak és fészkelési lehetőségek, táplálóknövények termelése, mesterséges fészekodvak kihelyezése útján. Az ilyen telepítések populáció gyarapításokról tanúskodnak a Szovjetunióban és Lengyelországban eszközölt rendszabályok és kísérletek eredményei alapján, melyek sok esetben a fellépett rovarjárást egészen 70%-kal tudták lecsökkenteni ;

hogy a madárpopuláció funkcióját az erdő életközösségében megérthessük, helyesen értékeljük, további alapos és széleskörű ökológiai és biocöno-

lógiai kutatásokra, az egyes fajok ökológiájának megvilágítására, valamint a madárpopulációk kutatására kell törekednünk a természetes társulásukban és életközösségükben. — Itt nyer fontosságot a rezervációk létesítése és az ezekben folyó kutatás ! — Egy esetleges madárkártevés esetében a kártevés okát kell felderítenünk, a madár (populáció) egyéb vonatkozásai után kell kutatnunk annak szemmeltartásával, hogy ez a madár, avagy az érintett populáció egyik és nem egyetlen tevékenysége. Az erdésznövendékek oktatásánál súlyt kell helyezni a madarak funkciójának megértésére, valamint arra, hogy az erdőt mint életközösséget, mint az állatok és növények társulását — még tipológiai vonatkozásokban is — igyekezzék meglátni mindenki, aki az erdő életébe valamikor is beavatkozik.

A CONTRIBUTION TO THE FUNCTION OF FOREST BIRD-POPULATION FROM THE POINT-OF-VIEW OF BIOCOENOLOGY AND FOREST MANAGEMENTS

František J. Turček

In respect to the production biology to the forest-bird-population (community lato sensu) belong all the birds which are feeding in the forest ; thus f. e. treesparrows, which come in during an insect outbreak ; while the hoded crow, which nests in forests, but is feeding chiefly in the fields or outside the forest community, is of minor importance to the forest as sparrow mentioned.

The function of a forest bird-population is quite different if judged from various points-of-view. To a forester f. i. the birds are an aid in his insect control (considered among the foresters either as an important or as a negligable factor of the resistance of the environment), some are — as f. i. the seed-eating and rapacious birds — assumed as ,,injurious''. On the other hand, the function of birds in forests is not only insect control, there are no ,,injurious'' birds : there is a bird community in a forest with a function as a whole and, further, the members of the community with functions which may change from one day to another, from one season to another. Therefore we connot speak of them as ,,beneficial'' or ,,injurious'' or even ,,indifferent'' birds or groups if we see the bird community as a whole and if we see the birds in their natural environment and, finally, if we consider the function of any bird, any population, community — and not separately the bird, regardless of its relations and correlations.

I made studies from the year 1940 in bird ecology, bioecology with special reference to the forest communities, chiefly in the broad-leaved and mixed forests in South- and Middle-Slovakia.

The methods used during the study were : population censuses (strip-census, plot-census with own method ,,birds per hectare per hour'', nest counting), study of the food habits of birds : stomach, crop and pellet analyses, direct observation, stored food, distribution of seeds, plus accidental observations during the study of insects, small mammals and game.

The forest bird-population (community) is correlated with the forest, thus the forest-type of vegetation : trees, lower stratum of shrubs and the undergrowth. In this correlation the chief role plays rather the type of forest

such as deciduous, mixed, evergreen, further oak-hornbeam, oak-beech, beech-fir, oak-pine, beech-fir-spruce, fir-spruce, pine-spruce, spruce, seedling forest, a. s. o., thus the segragation of the bird community, grouping of populations, birds is dependent more on the type of forest than the particular plant-species (*Kendeigh* 22, *Siivonen* 37). The type of the forest, is here considered in the sense of *Karpinski*'s (21) conception which corresponds with *Kendeigh*'s (22) communities such as beech-maple, pine-aspen, oak-hickory, a. s. o.

The present studies were carried out in the oak-hornbean, pine-oak, oak-beech, fir-beech, fir-spruce and spruce communities (types). Regarding to the bird population or community of various types there are various aspects according the seasons (spring, fall, summer, winter) and various groupings of birds according to the age of the forest (type) and, finally, changes due to the activity of man in the cultivated forests.

The bird community of a particular forest-type is so far correlated with this type that these types can be recognized from their own bird communities and *Kendeigh* (22) does distinguish such a "biocies" and "biociations" (terms introduced by *Kendeigh)*, thus communities as f. i. V i r e o-S e i u r u s broad-leaved forest, D e n d r o i c a-R e g u l u s neddle-leaved forest biociation a. s. o. It means, that the composition of the bird community of a type of forest is specific and the forest types can be named from either the characteristic plant or the characteristic (praeferent and specific forms according to *Friederichs*, 10) birds or — naturaly —other animals. If we would name f. i. our oak-hornbeam community from the characteristic birds, we would call it aequally "O r i o l u s-P a r u s (c a e r u l e u s) broad-leaved" type. Our knowledges but about the correlations of birds, their communities in the particular forest types are not satisfactory to such a classification and I mentioned it only for demonstrating the correlation of birds with forest communities.

Not only the qualitative, but also the quantitative composition of bird population is in a way an expression of the forest type. The density of bird population of a particular forest type is dependent on this type through food, nesting sites, song sites (ecological niches). According to these niches, the groupings of both animal and plant minor-communities, the patterness of communities, the bird population is not evenly distributed in a forest. This interspersion of populations was emphasized by *Elton* (5) and it means in our case that birds are not evenly distributed in a 1000 acre forest of a particular type, therefore the density could not be expressed in birds per 100 acres (or 100 hectares), but minor areas should be studied. Similar expressions of our population studies are of a relative comparative value. I studied bird populations on small areas of one hectare in size and found the following bird populations : oak-hornbeam, summer, insect outbreak : 27—30 birds ; oak-hornbeam, summer : 16—22 birds ; oak-hornbeam, autumn : 9—12 birds and in winter : 0,5—1 birds. In the oak-beech as well as beech-fir other communities above mentioned the pro hectare populations were much lower. In a forest edge shrub-community on the border of oak-hornbeam community the bird population was 37 birds per kilometer of edge.

The composition of oak-hornbeam bird community is approximately always the same and the both „characteristic" and "dominant" species are : jay, golden oriol, hawfinch, chaffinch, yellow bunting, tree pipit, nuthatch, blue tit, nightingale, warblers, black trush, cuckoo, pied woodpecker, a. s. o.,

while on the edge there are : red-backed shrike, nightingale, warblers, a. s. o. The biomass of the bird population in forests increases or decreases with the population density but not in a direct proportion to it. Therefore it might be n ore exact and — from the viewpoint of production biology and biocoenology, too — the only acceptable manner to express to dominance in terms of biomass (weight in grams, kilograms) per unit area, and to express the bird population in terms of biomass instead of terms in numbers.

We are coming to the function of bird population (community) in the forests. The population may be — according to various points-of-view — divided into different groups such as : according to the taxonomic affinity, according to various strata of forest community (crown-, shrub-, trunk-, undergrowth-, earth-stratum), according to horisontal stratification : forest edge-, interior-birds, according to the food consummed : insectivorous, herbivorous birds a. s. o. With reference to the bioecology and forest management, too, the only admittable grouping of bird population (and other animal populations, then the whole animal population too) of forests is the grouping to function (cf. *Karpinski*'s "functional groups", op. cit.) in the plant-animal community. It seems to me that such a grouping as constructed by *Karpinski*, (21), his zootonic (and florotonic) lists, respectively would be hardly the best solution, because the same bird (species) could have various functions in time and space, thus it occurs on various zootonic lists, in various "functional groups". We cannot, however, divide the *birds* of a community into various functional groups (statically), but we can recognize various *functions* of bird population (community) and the birds belong to the one or another, or to more or all the functions dynamically.

The bird population (community) of the forest in regard to its function can be divided as follows :

Bird community of forest biocoenosis

I.

Constructive function

a) distribution of seeds
b) preparation and cultivation of the soil
c) control of the damagers of the plants
d) control of the damagers of animals
e) regulation of the crops of seeds

a. s. o.

II.

Destructive function

a) feeding on seeds
b) making possible and haste the liquidation (reduction) of sick, not resistant and not viable plant and animal individuals or groups
c) to push out the plants and animals foreign to the community
d) to haste the mineralisation of plants or their parts
e) feeding on so called beneficial animals

a. s. o.

Maintenance of forest community
(of the biocenosis)

There are in a forest biocenosis much more functions, relations, correlations and interrelations, but, unfortunately, we do not know them. Therefore in the above table are exhausted the known functions only. In addition there are identical and similar functions regarding to the other groups of animal life than birds, too.

The trend of all — both constructive and destructive — functions of birds is the *maintenance of the biocenosis* of the forest, so far any function is performed by birds (groups of them) *belonging to the biocoenosis in mention*, say, to the own biocoenosis. The function of any other birds (group of them) foreign to the biocoenosis, equal either apparently constructive or destructive, is or my be (alternatively) disturbing and not in harmony with the events and life inside the biocoenosis.

It is a question of further investigation how far or if at all is the picture of own community, own biocenosis impressed or generally fixed in birds of any community (f. i. the jay and the oak-community) and how rapidly can change this fixation under environmental influences and changed conditions.

Now we shall analyse the particular functions, activity of birds in particular functions, respectively.

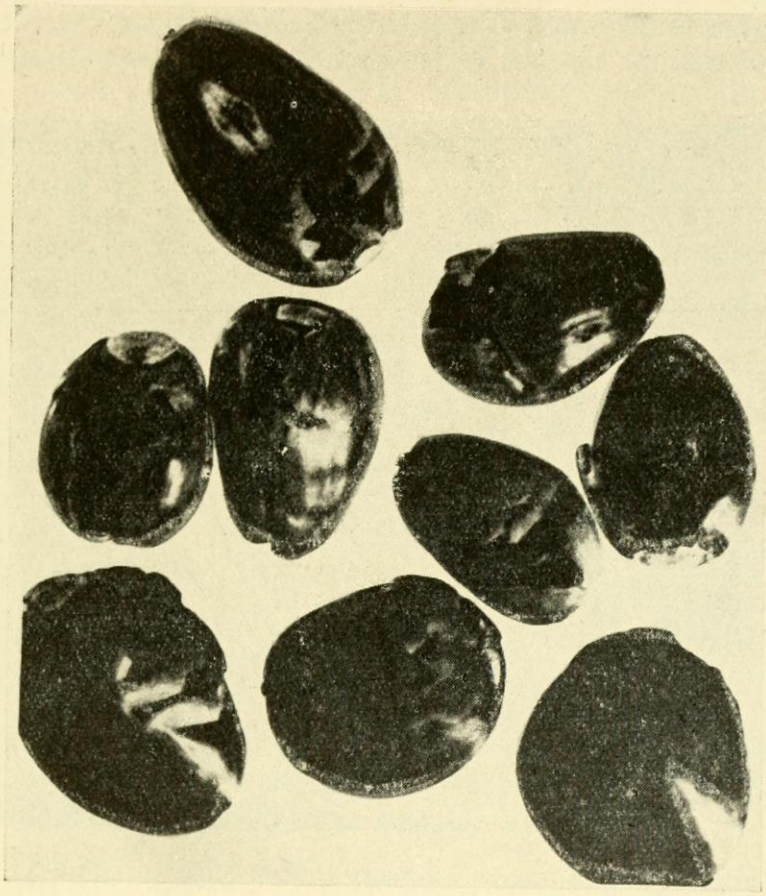
I/a. Distribution of seeds.

Almost all seeds — and fruit — eating birds do potentially distribute seeds of plants. The seeds (lato sensu as reproductive parts of plants) are distributed in three ways : by external adhesion (epizoochore dissemination), through alimentation (endozoochore dissemination) and in transport for forage (*Mc Atee* 29, *Mueller—Schneider* 32). This activity of birds is well known to bird-ecologists, bioecologists as well as foresters. Upon the matter exists an extensive literature over the world and for Europe it would be desirable such a compilation of literature regarding to the matter as we find in *Mc. Atee*'s (29) excellent paper, where he collected the literature upon the matter from the whole North America.

The value of the distribution of seeds by birds is underestimated often by foresters, because they refer chiefly to the feeding on seeds (our function II/a) taken by birds sometimes simultaneously. The foresters in the High Tatra mountains, f. i., do control every fall the nutrackers and jays, who are — according to them — feeding on nuts of the cembran pine and are destroying the whole crops of cones, nuts, respectively. The foresters have some commercial interests : they want cembran pine nuts for nurseries. On the other hand there are experiences that the artificial stocking, planting of the cembran pine has miscarried too often, it is expensive also, while the natural planting, made by birds as nutracker and jay (sometimes by small mammals, too) do maintain the cembran pine in its natural environment, say, stand on the transient zone between the upper edge of spruce and the lower edge of mountain pine. In fact the nutracker do maintain, plant up-hill and preserve the cembran pine in Alps and Carpathians. It is true that besides the dissemination (burrying the seeds under moss, lichens, stones and roots for storage) the nutrackers do eat seeds also and they do leave often no cones on the trees ; the question would be, if at all, what is more valuable : the maintenance, planting of the cembran pine over centuries, or the commercial effects from seedlings bred in nurseries or from seeds for commercial purposes.

The nutracker disseminates the hazelnuts, too. I shot in autumn nutrackers which had in their crops up to 6 nuts. In the vicinity of Banská Stiavnica in a sparse fir-beech forest, where are groups of hazel on small patches on the

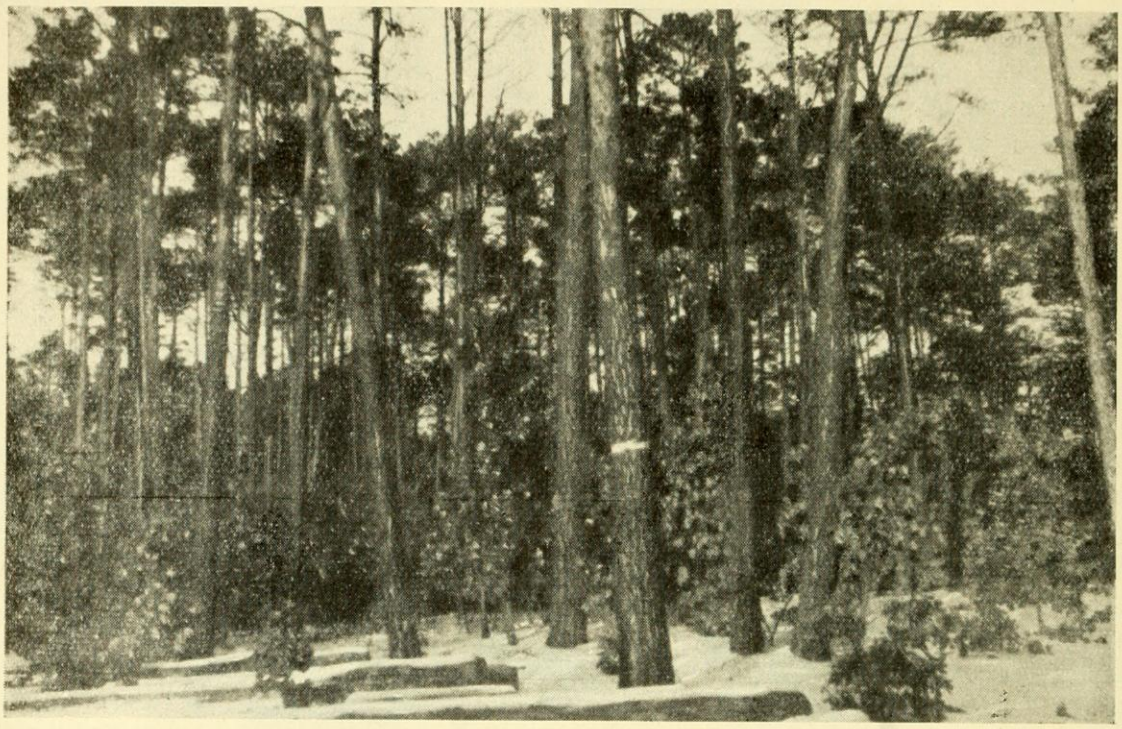
edge, around the fallen trees a. s. o., I observed from August during the winter a concentration of nutrackers, they feed on hazelnuts. In early April I found under the moss, almost on the mineral substratum stored nuts either singly or in groups of 2—4. The nuts were fresh and germinationable. The function of hazel in these forests would be to cover the soil and to protect the young fir seedlings, sown naturally, against the light. It is evident that a great many of stored, burried seeds (nuts) was not found by the birds.



8. ábra. Makkok, melyekből a szajkók a Balaninus-lárvákat kiették
Photo: F. J. Turček
Acorns, cleaned of Balaninus-larvae by Jays

The most important and valuable planter among birds is the jay, both the palaearctic and the nearctic forms. On the planting habits of the nearctic jay wrote *Mc. Atee* (29), *Grinnell* (13, 14) and other, while on the similar habits of the palaearctic jay, G a r r u l u s there are some data in works of *Keve* (24), *Feucht* (6), *Formozov* (6—a), *Koehler* (25), *Karpinski* (21), *Schwerdtfeger* (40), *Morozow* (31), *Mueller—Schneider* (32), *Turček* (46, 51) and others. The correlation of the jay and the oak is evident from the distribution of both over the palaearcticum. The distribution of both shows almost identical boundaries, as I demonstrated on a map (*Turček*, 51). The interrelation jay-oak may be outlined in followings: the acorns are the main food of the jay; a lack of acorn crops causes large movements of jay, movements often of a character of migration (*Keve*, 24), while a good crops attrackt and concentrate the jays in autumn; until the acorns are

not mature they are eaten after a previous peeling and are not stored (until late september in Slovakia); then the jays are feeding on larvae of insects inhabiting the acorns (Balaninus and Carpocapsa larvae); from late September on the acorns are eaten either on the there where found or carried off in two ways : singly in the bill or collectively in the crops of jays. This is the time of storing acorns under the debris, moss, stones, fallen leaves. The jays do regurgitate the acorns from their crops either singly or in groups of 2—4 (judged from the groups of seedlings of oak found) and with the bill do put them under moss a. s. o. (direct observation). Accidentally some acorns fall down from the bill of jays and (direct observation) the acorns



9. ábra. Fenyves belseje, melyet a szajkók tölggyel aláültettek
Photo : F. J. Turček
Pine-forest, having been underplanted by jays with oak

are regurgitated by jays also in surprise and affects (a jay regurgitated 9 acorns after a mishandled shot) and some of these acorns do germinate, too. Besides the more or less sporadic, dispersed planting of oak (all our kinds) in the forests there are known whole areas planted, undersown by jays. *Feucht* (6) calls them "Hähersaat" and *Morozow* (31) do mention such planting from the forest-steppe region of USSR. During a study of the pine bark-beetle outbreak in the pine forests of western Slovakia I found extensive areas of pine with a lower level (etage) of oak. I searched upon the origin of these oak-plantings and found that there are wide areas planted by jay only. The pine stands in the area mentioned are second-growth, originally there were mixed oak-pine and oak-hornbeam and oak types of forest. The forests there are on sandy sites, at an elevation of about 200 m, in the semi-arid zone. About 100 years ago the oak begun here to disappear due to the extensive grazing and browse of sheep herds. The oak was artificially oppressed, too, by man and was successively replaced by pine. There

survided some sedd-bearer oaks, now over 100 years old, dispersed in the pine stand in a stocking grade about 0,2. These old oaks were true source of food and of planting-materials to the reforestation activity of jays. The planting of acorns, oak, respectively, was begun by jays about 20—30 years ago, judged from the age of the lower canopy, level of the oak beyond the pine. The oak plantations are up to 25 years of age. In total there are planted oaks by jay solely on an area of 2277 hectares in the following degree: up to 20% (per cent from the full-planting) an area of 678 ha., up to 40% 727 ha., to 60% 472 ha., to 80% 77 ha and to 100% (full planting) 323 hectares. The foresters do help to these activity of jays (which are protected here) and the nature pine is succesively cut down, removed in winter cuttings and pines are leaved in a sparse stocking grade. Thus, the monospecific, artificial pine stand are changed into the oak-pine type, therefore we can consider it as a renewal of the biocenosis, reconstruction of the type. It is, however, evident, that this new type "in statu nascendi" will be not identical with the previous oak-pine type and, further is evident that without dynamics of the soil (which became able to carry a new, or renewed, oak-pine community) any change to oak-pine type could not be possible (*Turček* 51).

A further important aspect of the planting habits of the jay is the so called "up-hill planting" of oak, noted by *Grinell* (13). The acorns are heavy seeds and cannot move (except the gravitation-power downhill). Acorns are carried by jays up-hill, too, and the maintenance on slopes or the moving of oaks up-hill is possible only through the activity of jays (woodpeckers, nuthatches, small mammals also).

Besides the acorns, beech-nuts and hazel-nuts the jay do disseminate the yew *Turček* 44, *Kapuszcinski* 19), the mountain-ash (*Kapuszcinski*, 18), thorns and berries.

The magpie does distribute various seeds eaten with berries or accidentally. In the pellets of the magpie I found amongst others many seeds of the dogrose, hawthorn and black locust (*Turček*, 47).

The chaffinch does disperse beeach-nuts in fall and winter, also seeds of maples.

An important seed-distributor is the nuthatch with its storing habits. Seeds of oak, beech, hazelnut, yew, maples, basswood, hornbeam, Rhamus, Prunus spinosa, P. domestica, P. serotina, then common fir, Douglas fir, Pinus peuce, P. P. coraensis, P. flexilis, P. cembra ara stored, deposited into the cervices of bark and walls (*Mueller—Schneider*, 32). Many of them are forgotten, not found, others fall down and germinate. The tits, especially the Parus maior, P. ater, P. palustris are seasonally seed-eaters and do disseminate the seeds of conifers, of oak, beech and maple. In the similar way as the nuthatch does.

In the dispersal of seeds, especially those of berries and fleshy fruits, an important bird is the waxwing, in our country a winter visitor. *Warga* (53) collected data upon food habits of the waxwing during an invasion to Hungary. I observed the feeding of waxwings on dog-rose, mountain-ash, mistletoe, barberry, hawthorn, blackthorn, dogwood and the seeds of black locust, but I cannot tell, were these hard seeds digested by them.

Blackcap ate the fruits of Sambucus nigra in late summer, and yew. The dissemination of various seeds by thrushes is well known over the holarctic region. Our thrushes, namely Turdus pilaris, T. viscivorus, T. ericetorum, T. torquatus and T. merula do eat chiefly

fleshy fruits, as mistletoe, junipers, blackthorn, hawthorn, dog-rose, berries of the genus Rubus, of the genus Sorbus, less Viburnum, fruits of the yew, Symphoricarpus, Liguster, dogwood, Sambucus. Regardless of the rapid digestion of food, the thrushes disseminate some seeds — in their droppings — over wide areas. An interesting, say, neutralisation of such a dissemination I observed in a mixed coniferous forest. On the edge of the forest were black-thorns (Prunus spinosa) with a rich of fruits. During the December there were feeding flocks of Turdus pilaris, T. viscivorus and T. merula. Many of them roosted some hundred meters inside the forest on spruces, pines and larchs. The snow under these roosting trees was covered with blackthorn and other seeds. This place visited often a yellow-throated mouse (Apodemus flavicollis) and gnawed out the kernels of blackthorn. The blackthorn had no place in the interior of the forest, thus its seeds were destroyed, as intruders, or community-foreign elements.

In the Harmanec-valley in Slovakia there are on limestone-substratum well preserved mixed forest of the beech-maple-ash and beech-fire type, in the second level (etage) with many yew. It is probable that the majority of these forests is not of artificial origin, at least regarding to the beech-fire (maple) and yew. The yew is here maintained and distributed by bird alone, chiefly by thrushes, then by jays, nuthatches, blackcaps and robins over hundreds of years so that today the locality mentioned is the largest yew-habitat in Europe.

Black redstart ate during some weeks the fruits of Sambucus nigra in the fall and defended the shrubs against chaffinch, serin and chiffchaff (food-territory). Similary the robin ate the fruits of Sambucus nigra during August and Sept. It is known that the seeds of Sambucus-fruits are not digested and are disseminated in feces.

The woodpeckers, especially the pied- or spotted woodpeckers do play an important role in the seed distribution. Among these birds the great spotted woodpecker is the most seed-eater. It consumes seeds of both coniferous and deciduous trees, as Pinus silvestris, P. nigra, P. peuce, P. excelsa, P. montana, P. coraensis, P. cembra and others, all species of Picea, Pseudosuga, Abies (less), Larix, Tsuga, Cedrus, Chamaecyparis, Sequoya, acorns, beech-nuts, hazel-nuts, seeds of hornbeam, walnuts, the hard nuts of Carya, seeds of maple a. s. o. Cones and seeds are carried in the bill long distances, they often fall down, are lost or leaved uneaten on the work tree or elsewhere.

Birds of prey can distribute seeds indirectly if seed-carrying birds are taken, eaten, respectively and the seeds from gizzards, crops, stomaches of the prey are then — often at great distances — regurgitated in pellets.

Seeds, berries and cherries eaten by gallinaceous birds are regulary digested, thus these birds we cannot consider as important planters.

Birds functioning as platers are of large importance to the biocenosis and outside it in the geographical distribution of seeds, in succession of plant communities. There are still further items, do be considered.

The one is the fluctuation of plainting. After a heavy invasion of waxwings and northern thrushes, f. i. in the years following the invasion there is a rapid wide spread of various plants, the seeds of which distributed the birds in mention. Thus, the invasion of some birds causes an oscillation in plant-growth, in the qualititative and quantitative composition of various

associations together with all animal life linked with them. Similary the fluctuation of bird populations — so far these are seed-distributors — causes some irregularities in plant life : the fluctuations of bird populations can coincide, overlap or cross with the fluctuations of seedbearing, the seed-years.

The other is the distance of distribution. Regarding to the forest tree-seeds I observed distribution of acorns by jays over 400 m over a valley (up-hill), the distribution of yew-seeds by nuthatch to 700 m from seed-bearer, distribution of seeds of mountain-ash, Elaeagnus edulis and Amelanchier canadensis by thrushes over 300 m distance (all observations in the forestry arboretum in Banská Stiavnica (= Selmecbánya) (and carrying hazel-nuts and hornbeam seed (in knots) by pied woodpecker over 200 meters.

Formozow et coauct. (6—a) states that jays do transport acorns on distances of 2—3 kilometers or more in Kaukasus and that nutrackers do transport cembran nuts over areas 7—9 kilometers wide in Siberia.

In these ways birds also contribute to the patterness of plant and animal communities noted by *Elton* (5).

I/b. Preparation of soil.

Although in the preparation and formation of soil in the forest the worms, arthropods and small mammals are more engaged, the function of some birds in this way will be mentioned.

The thrushes, jays, nutrackers do rake in the fallen leaves, debris with their bills especially late summer, fall and winter. The gallinaceous birds of the forest do rake besides the leaves, debris in the soil (mineral soil) too, seeking for food and making their dust-bath. All the activity mentioned contributes toward the preparation of soil for an acceptance of seeds and their germination even there, where the canopy of debris and fallen leaves is deep so that fallen seed — especially the small ones — do not connect the mineral soil.

I/c. Control of damagers of the plants.

An extensive literature refers to the relation of forest birds to the injurious insects (plague), but a few only is based on quantitative data (*Turček*, 50). The control of insects, injurious to plants, trees, shrubs respectively in the forest community by birds is a further contribution of bird populations toward the maintenance of the biocenosis. This control activity of birds is in general considered as the chief, or even the sole role of birds of the forest communities. In fact this activity is only one role, although probably the most important economicaly.

A shortage of the investigation of the relation of birds to the injurious insects (injurious from the standpoint of forest management) is that this relation was in a majority of items studied during insect outbreaks, population-maxima of them, thus in the moment when the control capacity of birds against the insect population is the least one. Nothing or a few only is known on the pressure of birds upon the insects if their populations increase, decrease or at the low of the oscillation-curve or on the pressure of birds upon the insects which show no marked population fluctuations.

Quantitative data on the relation birds-insects are procured by works of *Franz* (7, 8, 9), *George—Mitchell* (11), *Kendeigh* (23), *Kuenkele* (28), *Kapuscinski* (20), *Formozow* et coauct. (6—a), *Osmolowskaja* (33), *Melnicenko* (30), *Sokolowski* (39), *Sweetman* (40—a), *Tinbergen* (42), *Turček* (50) and show that birds can consume up to about 70% of an insect population

in eruption (larvae), if artificially bred (titmice and starlings in nest-boxes), but a natural population of birds is able to consume 1—5%, sometimes more, of the insect population in outbreak. Not only the so called insectivorous birds do control the insects. The granivorous, fructivorous birds — in their seasonal change of food — contribute to the insect control, as is known on the hawfinch, chaffinch, crossbill and others.

All the types of damaging insects do have more or less specific bird-enemies, predators. Similary the different developmental stages of insects do have different, more or less specific bird enemies, as well as the insects living on the edge or in the interior of the forest. Thus, there is a distribution (stratifaction) of insects according to vertical and horizontal strata in the forest : in the soil, in the litter, on the trunk, lodge, inside the bark or wood, on the twings, leaves (leaf), in the buds, on the bark, then on the forest edge and interior. A similar stratigraphy show the birds according to their food habits and specialisation of food, food-requirements.

From the soil and leaf-muld are taken larvae and pupae of various insects by thrushes, pheasants, hazelgrouse, hoopoe, jay, woodcock ; on the soil feeds the shrike, gallinaceous birds, buntings, sometimes the thrushes and woopeckers, some birds of prey ; on the trunks are feeding the nuthatches, creepers, from the wood and bark are taken the xylophangous forms of insects by woodpeckers ; on the twings and buds, from the galls are taken aphids, larvae of Lepidoptera, Diptera an Coleoptera, as well as various imaga by tits, finches, crossbills, warblers, woodpeckers, kinglets a. s. o. ; on the leaves, generally in the crown are feeding tits, finches, starlings, oriole, warblers a. s. o. ; in the space between and above the crowns of trees are feeding flycathers, nightjars, shrikes, swallows ; on the forest edge controls the insects the shrike, magpie, some warblers, treesparrow and others.

It would be a too wide material to discuss here all the bird activity in this function. Only some items should be mentioned here, for an illustration of the control activity of birds.

The thruses do eat elaterid larvae, cocoons of some lepidoptera, the hoopoe do eat cocoons and pupae of sawfly, of Uropus and of some beetles. The nuthatch and creeper eat spiders, aphids and sucking homoptera. The woodpeckers, especially the black, green, the lesser spotted-, the white-backed, the three-toe-woodpeckers do control bark-beetles, wood-boring lepidoptera larvae (Cossus, Zeuzera), larvae of wood-boring beetles (Cerambyx), wood-ants a. s. o. The nuthatch, tits and woodpeckers do eat larvae of gall-producing insects (Cynips), the crossbils eat the gall-producing and other aphids (Chermes), the kinglets eat aphids on twings, buds, needles, small larvae in buds, the oriole, hawfinch, chaffinch, starling, sparrows, jay, warblers eat lepidopteran larvae (Lymantria, Cacoecia, Panolis, Dendrolimus, Tortrix, Hybernia), while the shrike (red backed and lesser grey shrike) has an important role — together with magpie and a few other edge-birds — to control the insects on the edge, which move in or move out of the forest, thus these birds control the community-foreign insect forms and these, which do have a part of their own life-cycle either in the forest or in the fields (Melolontha, Rhizotrogus, Anisoplia, some leaf-and grasshoppers a. s. o.). The jay eat in large quantities larvae of Balaninus and Carpocapsa (Laspeyresia) inhabiting oak-acorns.

Some birds of prey, owls and crows, shrikes a. s. o. do control the small mammals, especially rodents such as wood-mice, red-backed voles, common

voles, yellow-throated mice and squirrels, thus herbivorous animals, belonging to such group of animals as the herbivorous insects belong in the forest community.

I/d. Control of the damagers of animals.

To this function belongs the activity of birds in controlling the parasites, episites and predators of other animal life, such as parasitic flies and their larvae (flycatcher, tachinid larvae eaten by wild pigeons on the soil) eating of wesps, of rapacious beetles, of lice and ticks, of ants, eating of parasitic hymenopters, some mouse-like rodents and shrews, the so called cannibalism between owls and birds-of-prey, control of that animals which are vectors of epizootics and finally feeding on carrion.

I/e. Regulation of crops of seeds.

During the winter of 1949/50 I observed an intensive feeding of squirels and crossbills on the flower-buds of some firs (Abies alba, A. numidica A. grandis). Under these trees lay thousands of little twings throwed down by crossbills and squirrels and the buds were eaten out. In spite of these loss the trees in such manner damaged have had a rich crops of cones. Similary some buds of both coniferous and deciduous trees are eaten by bullfinch, crossbill, hawfinch, chaffinch, greenfinch and others in late winter or early spring — I observed eating of flower-buds of the blackthorn in late March by bullfinch — and some small fruits or flowers or buds of some fruit-bearing trees (apple, plum) are eaten, too, by sparrows, finches a. s. o. It might be assumed that the birds removed the surplus of crops (potential crops), the surplus which might be of an unfavorable influence and effects upon the future quality of crops as well as upon the viability and resistance of the tree in mention.

I/f. Maintenace of undergrowth and forest edge.

The bio-ecological significance of the undergrowth (shrub-stratum) and forest edge shrubs, rows is wide in the forest community. It is a cover of soil and of lower plant-canopy, a regulator of the humidity, a source of food for invertebrata and vertebrata, cover and nesting-sites; the shrub-stratum and forest edge shrub-row do retard some pests, attacking the trees (it is f. i. known that the losses due to gypsy-moth larvae are less in stands with dense undergrowth) and the forest edges retain much of insect-influx, retain the power of wind from outside a. s. o. Thus, these significant components of the community — undergrowth and forest edge, are maintained by birds almost alone : birds distribute the seeds of shrubs and low trees belonging to this type of growth and do control the enemies of these plants.

II/a. Feeding of birds on seeds.

The feeding of birds on seeds — in this case on forest tree and shrub-seeds — is either not noted by naturalists and foresters or overestimated and considered as an injurious activity of birds in the forest community. In fact the consumtion of seeds by birds is enormous, but this is linked with the dissemination of seeds by birds (cf. the so called ornithochoryl seeds) and — according to *Formozow* et coauct.'s (6—a) statement — seeds make possible to birds to survive in hard winter months and seeds are the reward and repay of the community to the bird population for its other activity favorable to the seed-bearers round the year. Often the seed eating of birds is linked with the function II/c, as will be showed later on.

Before giving some quantitative data on seed-eating of birds, some qualitative data should be shown here according to my own observations in Slovakia.

The seeds of :	are eaten by :
oak (all kinds)	jay, nutracker, hawfinch, chaffinch, green-finch, nuthatch, great-tit, great spotted woodpecker, middle and lesser spotted woodpecker, mallard, wild pigeon, turtle-dove, ringnecked pheasant
beech	nutracker, jay, chaffinch, nuthatch, great-tit, coal-tit, marsh-tit, blue-tit, great spotted woodpecker, wild, pigeon, pheasant.
hornbeam	nutracker, hawfinch, nuthatch, great spotted woodpecker, chaffinch
maple (Acer campestris)	nutracker, hawfinch, greenfinch, bullfinch, nuthatch, great-tit, marsh-tit, great spotted woodpecker, waxwing.
Acer pseudoplatanus	hawfinch, greenfinch, bullfinch, nuthatch, great spotted woodpecker, tits.
elm (Ulmus campestris, U. montana)	greenfinch, chaffinch, goldfinch.
birch	bullfinch, goldfinch, siskin, tits.
ash	bullfinch, hawfinch.
alder	bullfinch, siskin, goldfinch, greenfinch.
basswood	hawfinch, chaffinch, greenfinch, tits, nuthatch, pheasant.
walnuts (Juglans regia, J. nigra J. cinerea)	great spotted woodpecker, nutracker, jay.
hickories (Carya alba, C. ovalis)	great spotted woodpecker
hazel nut	nutracker, jay, nuthatch, great spotted woodpecker
misteltoe (Loranthus, Viscum)	thrushes, waxwing, robin, pheasant, hazelgrouse
barberry	thrushes, waxwing, robin, nuthatch, chaffinch
firethorn	thrushes, robin
hawthorn	thrushes, waxwing, chaffinch, bullfinch, magpie, greenfinch, pheasant
mountain-ash	thrushes, waxwing, hawfinch, chaffinch, robin, tits, jay, magpie, pheasant, hazelgrouse
serviceberry (Amelanchier canadensis)	thrushes (black, song, mistle-thrush), robin, warblers
wild rose	waxwing, thrushes, tits, bullfinch, magpie, goldfinch, chaffinch, pheasant
cherries, plums :	
Prunus padus	blackbird, blackcap, hawfinch
Prunus spinosa	thrushes, waxwing, tits, robin, nuthatch, jay, magpie, bullfinch, hawfinch, pheasant
Prunus serotina	thrushes, hawfinch, warblers, robin
Black locust — Robinia pseudo-acacia	magpie, bullfinch, hawfinch, chaffinch, tits, nuthatch, greenfinch, pheasant
Hoptree — Ptelea trifoliata	siskin, greenfinch, bullfinch, great-tit, marsh-tit, coal-tit
Strawberrybush — Evonymus europ.	magpie, nuthatch, pheasant
Buckthorn — Rhamnus cathartica	nuthatch, blackbird, robin, warblers, tits
Silverberry — Elaeagnus edulis	blackbird, songthrush
Cydonia japonica	tits (seeds from aples gnawed out by mice)
Dogwood : Cornus mas and C. sanguinea	hawfinch, bullfinch, robin, hazelgrouse, blackbird
Spirea, Deutzia	bullfinch
Syringa vulgaris	bullfinch
Snowberry — Symphoricarpus sp.	blackbird, bullfinch

Privet — Ligustrum vulgare	blackbird, robin, waxwing, bullfinch, pheasant
Elder — Sambucus sp.	blackbird, songthrush, mistlethrush, robin, blackcap, redstart, serin, chiffchaff, pheasant
Fir :	
Abies alba	nuthatch, crossbill (immature cones)
Abies numidica	crossbill
Pseudotsuga douglasii	nuthatch, greenfinch, coal-tit, crossbill
Pseudotsuga taxifolia	crossbill, great spotted woodpecker
Spruce :	
Picea excelsa	crossbill, greenfinch, great-tit, coal-tit, great spotted woodpecker
Picea orientalis	great spotted woodpecker, crossbill
Picea mariana	great spotted woodpecker (immature cones)
Larch :	
Larix decidua, L. leptolepis	crossbill (immature cones), great spotted woodpecker, greenfinch, tits
Cedrus libani	great spotted woodpecker
Pine :	
Pinus silvestris	great spotted woodpecker, greenfinch, great-tit, coal-tit, marsh-tit, crossbill
Pinus peuce	great spotted woodpecker, nuthatch
Pinus pugens	great spotted woodpecker
Pinus cembra	great spotted woodpecker, nutracker, nuthatch, jay, great-tit, crossbill
Pinus coraensis	great spotted woodpecker, nuthatch, great-tit
Pinus flexilis	great spotted woodpecker
Pinus montana	great spotted woodpecker, crossbill
Pinus palustris	great spotted woodpecker
Pinus strobus	great spotted woodpecker, nuthatch, great-tit, coal-tit
Dwarf juniper	blackbird, songthrush, mistelthrush, fieldfare, robin, waxwing, great-tit
Yew (Taxus baccata)	hawfinch, nuthatch, greenfinch, jay, robin, blackcap, songthrush, blackbird, mistelthrush
Chamaecyparis pisifera	siskin, bullfinch, greenfinch, hawfinch
Thuya gigantea	hawfinch, bullfinch
Sequoia gigantea	great spotted woodpecker

There is a lack of quantitative data on seed-consummtion of birds and if the economic importance of this activity of birds should be considered this should be on a quantitative basis. In the literature there are some valuable quantitative data as *Franz* (9), *Hartley* (17), *Smith & Aldous* (38), *Karpinski* (21), *Formozow* et coauct. (6—a), *Turček* (51), but a systematic work is needed on this matter.

I observed the seed consumtion of great woodpecker (which I assume as a seed-eater round the year with a little participation of animal-food in its diet) during the winter, fall, resp. of 1948. In the forestry arboretum near Banská Stiavnica there are plots with various — about 300 kinds — native and exotic trees. On a plot is Picea orientalis. In 1948 was a good seed-year there and the whole crops of cones was destroyed by squirrel and great spotted woodpecker. The crops was a total of 4475 cones (from 38 trees). From these the great spotted woodpecker — one individuum — destroyed, resp. ate the seeds of 1809 cones in the time from late August to March. — On an other plot with cembran pine again one woodpecker (great spotted) destroyed the whole crops of cones of cembran pine, total 238 cones from 27 trees. In the time from late June to late July, thus before the seeds became mature. This habit of the woodpecker, i. e. consumming seeds from immature cones (also immature hazel-nuts in August) I observed during more years from June up. The great spotted woodpecker is the at least insectivorous among all our woodpeckers. — During the winter of 1947 a small flock of

bullfinches destroyed the whole crops of a single ash (Fraxinus excelsior). There were 5—8 birds and they fed day by day on the ash-seeds so that from October to late December about 5—6 kg. of seeds was destroyed. Similary the whole crops of seeds of American ash in the arboretun, from 43 trees on a plot destroyed during the winter of 1948 — by bullfinches.

A single elm-tree (Ulmus montana) was under my observation in the sping of 1950. The tree grows on the border of gardens where these join the fields. The tree is about 100—120 years of age. The seed-crops was very good in 1950. From 18th May some greenfinches visited the tree and ate the immature seeds. The whole population of greenfinches of the vicinity, about 10—12 birds, fed on the seeds systematically. The wings of seeds eaten fell down and the soil was covered with these wings. In last days of May the seeds became mature and fell down. On a plot one meter square I found a total of 1430 seeds, from which 840 were uninjured, while 590 were eaten out by greenfinches. The fallen seeds and wings covered an area of 320 meters square, with a total of 457,600 seeds, from these 188,800 were injured, eaten respectively (there were the wings of seeds only), thus about 41 % from the whole crops. The greenfinches not only ate the seeds but apparently they fed youngs with them also.

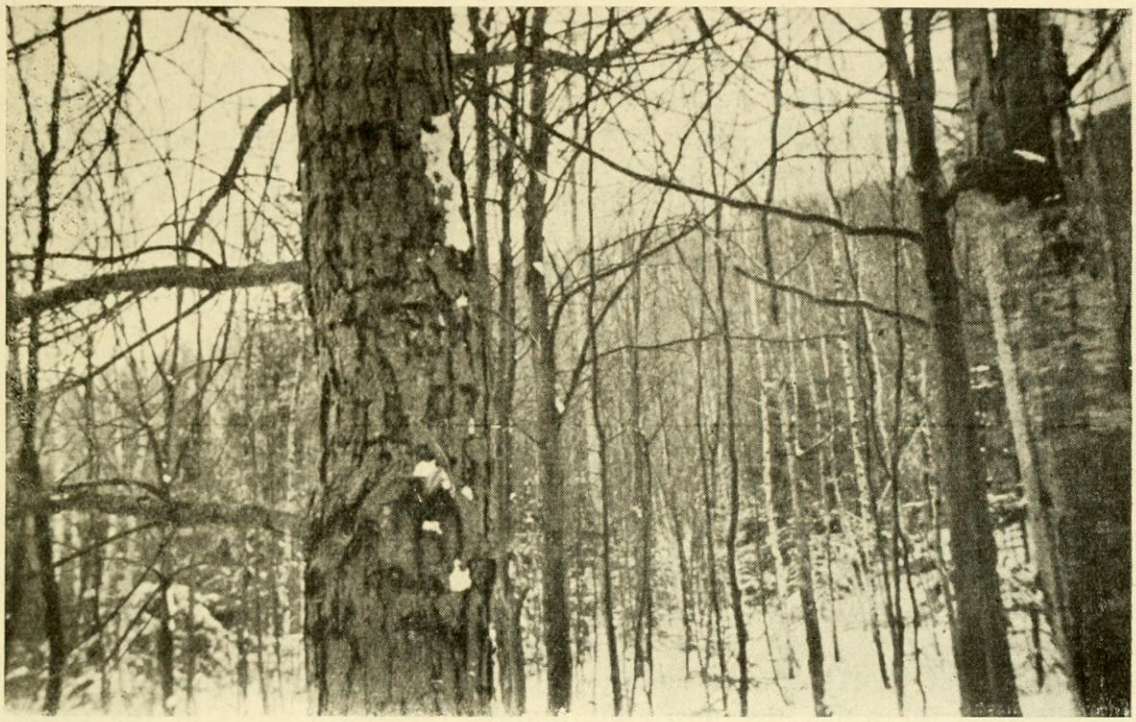
The seeds of forest trees and shrubs, thus, are an important food of many birds and the shortage of any seed-crops may cause deep both quantitative and qualitative changes in the bird population during the winter especially. *Rudkovsky* (36), all over, made an attempt to qualify some birds, bird communities of the forest on the basis of available seeds-resources in the various forest types during the winter.

II/b. Liquidation of sick, non resistant and not viable plants and animals.

Just as the printing bark-beetle attacks spruce, the viability and resistance of which was lowered by drought, wouding a. s. o., the birds of a forest community attack non resistant, sick and not viable enough trees, shrubs and animals of own or other group. It seems probable to me that a woodpecker seeking bark-beetles and simultaneously boring and digging the tree functions as a liquidator, destroyer of these trees, which lost its full value for the community. Similary the green-woodpecker, seeking wood-ants in a standing tree does haste the liquidation — then mineralisation — of that tree. It is known that on sick, not resistant and not viable enough trees, shrubs there parasitize some fungi. But such trees as mentioned, are often visited be woodpeckers also. It is evident that these woodpeckers are vectors of spores of the fungi (*Turček*, 48) from one tree, sick, not resistant tree respectively, to another. Especially important are in this matter the wide ranging species of woodpeckers, such as black and green woodpeckers, while the spotted woodpeckers are more of local importance. I assume that the main function of woodpeckers is as suggested above. In a previous paper (48) I noted the consumtion of stones of monilious (the fungus Monilia cinerea) plums in winter by great spotted woodpecker and the probable distribution of these fungus in such way. To this function belongs perhaps the distribution of the mistletoe by thrushes, too. The second "functional group" *Karpinski*'s, 21). Here belongs f. i. the eating of pine needles on elected trees by capercallie noted by *Lindroth & Lindgren* (Matson hakomisen metsänkoidollisesta merkitykksestä. Suomen Riista, 5, Helsinki, 1950), who studied the food habits of capercallie in winter and state (p. 81): "...It has rarely been

found that the capercallie would attack well formed pines. Also as to their technical quality the trees from which the capercallie gets its food have mostly been poor with crooked or twisted trunks or else decaying."

The removal of not viable enough, sick or not resistant animals of the community is the daily activity of birds of prey (and other predatory animals) but also of other birds of the community. On 16. VI. having been studied bird population of an oak forest I heard in an oak thicket the alarm note of the magpie. If I came to the place, three young magpies flow off and the parents alarmed further. On the earth under a shrub I saw something moving : there a juvenile magpie was attacked by and old jay. I shot both of them.



10. ábra. Nagyfakopáncs által „gyűrűzött" fenyő. A fenyőfa lomberdőben állott
Photo : F. J. Turček
Fir-tree, "ringed" by Great Spotted-Woodpecker

The juvenile magpie was well developed one, but its lower mandible was about 10 mm longer as the upper. Thus the jay — which otherwise does not attack fully fledged magpie — took a selective work in that case. — In the same forest I observed the feeding of youngs by adult roller. In a half day the adult bird twice brought in its bill lizard (Lacerta agilis) with apparently previously broken tail.

II/c. The repression and pushing ot the plants and animals foreign to the community.

In a previous chapter I mentioned that some seed-eating or destroying of a great part of seeds, buds and other parts of plant-bodies does belong to these function. The mentioned destroying of elm-seeds by greenfinches, the destroying of cembran pine cones by woodpecker in the arboretum aims to repress the community-foreign plants.

The ringing or drilling of trees made by woodpecker (especially and chiefly by great spotted woodpecker — *Turček*, 43) is well known in European

forests. Generally it is supposed that the woodpecker drills the trees in order to obtain sap (the sapsuckers of the nearctic region). All authors agree that shiefly the "mixed-in" trees are ringed ("eingesprengt" of German authors), It is true : in oak-hornbeam type of forest I found drilled pines, in pine forests hornbeams (but also in oak type), in mixed broas leaved forests basswoods, in beech-fir type I found drilled yews a. s. o. The drilled trees are open to an attack of fungi and xylofaguous insects. What it is, if not a repression of community-foreign plants? It is a similar, even identical activity, as the antler-polishing of deer and roebuck made on "mixed-in", or even the overbrowsing of "mixed-in" plant species (artificially mixed) by deers and roes. Also the hare and rabbit attack, browse and gnaw chiefly the artificially planted seedlings.

In relation to animals it appears that even the community-foreign species often become too abundant and are able to build up enormous populations. That might be explained, perhaps, by the lack of enemies, the specific ones, by the low resistance of the environment. But also the opposite case is known. The stocking of king-pheasant in some forests, the introducing and stocking of Alectoris graeca in the High-Tatra a. s. o. was unsuccessful besides that the climatic and — apparently — environmental conditions were favorable. These birds were community-foreign and were repressed, pushed out and disappeared.

II/d. Acceleration of the mineralisation processes of plants.

The microorganisms accelerate and make possible the mineralisation of the litter, debris, fallen, leaves in the forest, thus contribute to the rotation of materials in the community. In a similar way birds contribute to the mineralisation of plants or parts of them. All birds which build a nest, do use to that building fresh or dead plant-parts, some animal-borne materials also. The mass of the nest material in a forest is relatively large : if we assume a population of 20 birds per hectare of forest, the nest-mass could be estimated from 1,5 to 4 kg. per hectare. Making nest holes in dead or decaying trunk, destroying of dead trunks or stumps and branches (the woodpeckers do work, dig and split mainly the lower parts of the standing dead trees, which causes a fall-down of the tree) all aims to a mineralisation of the plant bodies.

II/c. Feeding on so called beneficial animals.

The beneficial animals in the forest community are — from the standpoint of the forester — the predacious and parasitic animals of the pest organisms. They must be — similary as all the members of community do — in a dynamic balance not only with the prey-species, but also with other members of the community. In the previous years I have studied the outbreaks of the gypsy moth in the oak-hornbeam community. The population curve of the moth and those of the most important enemy among beetles — Calosoma sycophanta is different : the population of Calosoma culminates usually after the eruptionphase of the moth. But in eruption of the moth already the density of the Calosoma-predators too high. In that time the Calosoma was decimated by rollers, magpies and shrieks (other birds not studied regarding to this matter) and also by foxes and badgery, shrews and hedgehogs. Thus the population density was lowered by these animals. In the year following the gypsy moth outbreak there were far less Calosoma and practically no moths. The Calosoma were decimated again, thus the intraspecific competition for food between them was in that way mitigated

due to the activity of birds (and other animals), which again resulted in a better survival of the Calosoma population on its sinking edge of the curve or in the minimum.

The item with the gypsy-moth and Calosoma was recorded here in order to show that there exist circunstances if the so called beneficial animals might be useless however, to the community and, further, to show that the occurence of so called beneficial animals in the diet of other animals should not result in a persecution of the laters, for always all the interrelation in the community must be considered.

Conclusions

The biocenosis in general needs all the living organisms belonging to it, thus the biocenosis knows no useful and harmful animals or plants as far as these belong to the biocoenosis. The forest is — and must be — considered as biocenosis of a particular type. Recent trends in the forestry conceive the forest as a whole, thus plants, animals, soil and climate ("biogeocoenosis" *Sukacew*) and the science which studies that whole, should be called hylology. Neither the plant-world or any component of it, nor the animal world or any component of it, neither the soil nor the climate should be studied separately in hylology. It means that birds should be studied not separately, either. If the birds of the forest community will be studied in that way, thus in relation to other organisms of the community it will be inpossible to discriminate birds in artificial groups such as "useful" and "harmful" for not the birds as such, as a species but their function, activity in the community should be the matter of the study in hylology, biocenology respectively. To know the function of particular birds of the community, their ecology must be studied, which again means to study their relations, interrelations and correlations to both plant and animal members and climate of the community. The trend of the study of bird populations of the forest community is therefore clear. And what about the forestry of today? The relation of forestry to the birds here in Central Europe is, however, well illustrated in the manuals of forest-protection and sylviculture : there we can find "useful" and "destructive" birds. It is however, true that the quantity of the "harmful" birds gradually sinks down. — *Pavlovskij* (34) in relation to forest knows no injurious birds and in relation to agriculture only one : the sparrow ! — That provides that the knowledges on the function of birds multiply, but provides also that the forestry was not set free from the old-fashioned conception until now.

I have discussed on birds of the forest biocenosis. In Central Europe there hardly exists any primeval forest, thus the forest biocenoses all carry the influence of man. Man is, however, the most powerful factor among the biotic factors of environment of the forest biocoenosis and its effects upon the biocenosis are equally powerful. But, on the other hand, among all biocoenoses of the settled land the influence of man and its civilisation is the least one in the forest — if we consider the relatively long growing-time of the trees, the not rapid rotation, and this all indicates that the habits, the functions of birds of forest biocenoses are most naturally one. Therefore it seems to me that if the birds anywhere in the forest would cause damage to the forester thus there the forester made some fault and the birds just indicate to him where the fault might be.

If a damage caused by birds occurs in the forest — such as eating of seeds, damage on nurseries, depredation of game animals a.s.o. — the cause of the damage must be searched for and none-the-less the other functions of the bird in mention must be considered before judged. For :

Nothing exists for itself, but only in relation to other organisms *(Darwin)*.

Summary

1. Each type of forest is characterized by its own bird-population (community). Both the qualitative and quantitative composition of the bird population of any type are the direct expression of that type, and the conditions inside the type.

2. The bird population of any forest type is not evenly distributed, but there is a patterness of both birds and other populations of living organisms. The usual expressions of the densities of bird populations in terms of birds per 100 hectares (100 acres) are generalisations of a comparative value. Author believes that small areas should be studied according to patterness of the populations.

3. Densities of bird populations in the broad-leaved forests in Slovakia fluctuate between 0,5 bird per hectare and 30 birds per hectare in winter, summer respectively. It would be better to express bird densities as well as dominance of populations in terms of biomass (units of weight).

4. The bird population of any forest community can be classified from various standpoints, such as food, vertical and horizontal stratigraphy, taxonomic affinity a.s.o. For the purposes of the bioecological work a classification of bird community (its members) according to the *function* in the community would be the most natural, suitable and dynamical. Therefore not the birds as such, but their function should be considered in the forest community. In this way it appears that the same bird acts in various functions. The functions of the members of a bird population of any forest type are both constructive and destructive (as two antitheses) which result in the maintenance of the biocoenosis (synthesis), respectively in the contribution of bird population — as a part of the whole — to the maintenance of the biocenosis. Some constructive and destructive functions of the birds are mentioned, and in the particular functions some examples (items) are stated.

5. There are two main standpoints for evaluating bird activity (birds) in the forest : the biocoenological and the economical one. The basis must be the biocoenological standpoint, for deep and solid knowledge of the biocoenological functions of birds only should be the basis for economic evaluation.

6. In the forest biocenosis there are no injurious and no beneficial and indifferent birds. There are injurious and beneficial functions of the same bird (birds) limited in time and space. All these functions contribute to maintain the biocenosis, the dynamical balance inside it.

7. From the standpoint of forest management the birds in the forest are of large significance as : distributors of seeds ; they control the insect pests but are not able to liquidate any outbreak of insects, because the insects as food are far above the capacity of the birds and the reproductive potencial of birds is far below the one of the insects ; birds are important convectors of plant and animal matter in the community ; they contribute to mineralisation of the plant and animal bodies and prepare the soil for seeds ; birds control the small mammals, rodents especially, injurious to the reseeding of the forest ; birds control constantly the not eruptive (oscillating) populations of insects and diminish the damage caused by insects on trees and forest-plants, chiefly the so called complex-damage ; birds prolong the intervals between particular insect-eruptions.

8. For the forest management in cultivated lands (the second growth forests, man made forests) the following measures could be suggested : in the sylviculture to avoid the monocultures, which are unsaturated communities with a poor bird population and low resistannce in relation to the insect pests and damage caused by elements;

in wood utilisation to avoid the clear-cutting and similar practices, which mean a drastic interference into the life of forest ;

in the forest protection — which should be based on sylvicultural practices — to rear mixed forests, which are more saturated communities with a rich bird population and maior resistance ;

the mixture, respectively the grade and mode as well as the election of mixing the trees and shrubs should be a result of biocenological study whereat the birds can indicate whether the mixing is suitable to the existing community ;

in existing monocultures threatened by insect pests bird populations should be artificially raised by protection, winter feeding and artificial nestboxes and holes, because such practices in USSR and Poland resulted in a well multiplication of birds and in a control of insect pests up to 70%.

9. To study the birds as an integral part of the forest, at a damage by birds to search for the causes of damage and for other relations of birds, because the eventual damage is only one of the activities of the birds in mention and not the only activity.

10. In education to lay stress on the function of birds, on their ecology and to teach to understand the forest as a community, as a whole and integrity.

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Пособие к ознакомлению с функцией населения лесны птиц с точки зрения биобенологии и лесоводства

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Краткое содержание

1. Каждая лесная порода характеризуется своим птичьим населением. Количественное и качественное сложение этого населения является прямым последствием лесного насаждения т. е. жизненных условий этой лесной породы.

2. Птицы леса — определенной лесной породы — не разделены равномерно в этом насаждении, в этом лесном общежитии: птицы, как и другие животные и растения, живут по группам. Вследствие этого означение — которое в экологии является обычным — густоты птичьего и другого населения по головам (парам) на 100 га учетной площади надо считать обобщением с относительным числовым значением. Принимая во внимание это групповое расселение, автор предлагает исследовать меньшие площади внутри лесного общежития.

3. Густота птичьего населения в лиственных и смешанных лесах южной Словакии колеблется — согласно исследованиям автора — между 0,5 и 30 птиц на 1 га. Автор предлагает обозначать густоту, как и преобладающую птичью породу, в единицах биомассы — веса — вместо теперешнего означения числами.

4. Птичье население определенного лесонасаждения можно разделять с разных точек зрения, напр. по качеству пищи, по стратиграфии, по систематическому родству и т. д. Для нужд биоценологии более целесообразным и естественным является динамическое разделение птиц лесной породы по учению Сукачева согласно функции, которую исполняют птицы или отдельные члены птичьего населения в жизненном общежитии, каким является лес. Поэтому мы не рассматриваем птицу как индивидиум или как птичью породу, а рассматриваем ее с точки зрения функции или функций. Таким образом, определенная птица — индивидиум или порода, вид — совершает различные функции, принимает участие в разных функциях внутри лесного общежития.

Функция птичьего населения как всех, так и отдельного члена в лесном общежитии является созидательной (напр. распространение семян, подготовка почвы к посеву, уничтожение растительных вредителей и т. д.) и сокрушительной (напр. поглощение семян, ликвидация и ускорение умирания больных, не очень жизнеспособных и устойчивых индивидуумов растительного и животного мира общежития, изгнание чужих для общества элементов из растительного и животного мира, ускорение минерализации растительных телес и т. д.). Эти две группы как две антитезы являются в итоге синтезой, а именно в сохранении биоценозы, точнее в аликвотном участии птичьего населения в сохранении биоценозы.

5. Функции птичьего населения леса можно рассматривать с точки зрения биоценологической и с точки зрения экономической, т. е. лесоводства. Если мы хотим представить себе точную картину функции птичьего населения с экономической точки зрения, основанием нам должно служить биоценологическое исследование.

6. В лесном общежитии — биоценозе — нет ни полезных, вредных, ни равнодушных пород птиц (индивидуумов), но есть только полезная и вредная деятельность — функция — птиц, принимаемая динамически, ограниченная временем и пространством которую может совершать определенная порода птиц (индивидуумов). Все функции птиц способствуют сохранению биоценозы, удержанию колеблющегося равновесия животного общежития. Такое понимание функции птичьего населения возможно лишь после исключения метафизического понимания явлений в природе-биоценозе.

7. С точки зрения лесоводства птичье население (в которое мы включаем всех птиц. находящие свою пищу в лесу), имеет большое значение главным образом в следующем : оно распространяет смена многочисленных лесных пород, о чем было написано в статье о дубе и о некоторых кустарниках, жизнь которых зависит от этой функции птиц, уничтожает растительных вредителей, именно насекомых, но не в состояни и преодолеть массовое их размножение, эту катастрофу, потому что численность насекомых в этот период неудержимого — вулканического — размножения как пища не может быть воспринята птичьим населением, потому что птичья способность размножения слабее способности размножения насекомых; птичье население способствует изделению и обмену веществ внутри общежития, способствует минерализации растительных и животных веществ ; рытьем и повреждением плодородного слоя оно приготовляет почву к принятию семян; уничтожает мелких млекопитающих, главным образом грызунов, которые являются часто большим препятствием естественного и искусственного возрождения леса ; птичье население контролирует население тех насекомых, которые не проявляют никаких колебаний в размножении, значит уменьшает убытки, которые наносятся массами насекомых (напр. многими видами гусениц) ; удлиняет промежутки между отдельными градациями вредных насекомых ; особенной функцией птичьего населения является изгнание и ликвидация чужих для лесного общежития элементов, чем оно способствует сохранению лесной породы, его количественного и качественного сложения.

8. Во второстепенных хозяйственных лесах были бы необходимы следующие мероприятия : переделать однолетние и однородные лесонасаждения на разновекие и разнородные леса, которые часто населены обществами с богатым птичьим населением и которые более устойчивы как против вредителей, так и против природных катастроф; в лесной эксплоатации отказаться от корневой вырубки леса и подобных методов эксплоатаций, которые являются большим роковым посягательством на лесное общежитие; защиту лесов основывать на лесоразведении с постоянным вниманием на возраст и породу деревьев.

Перед выбором пород деревьев и поросли, и вообще породы целого леса и его возраста, должно состояться биоценологическое исследование, которое решит, в какой смешанной лесокультуре и в каких собственных и чужих элементах нуждается птичье население в существующих однородных лесокультурах, которым угрожают вредные насекомые, можно ли густоту птичьего населения увеличивать искусственной охраной, зимней кормежкой, разведением растений служащих кормом птицами, и уходом за ними, приготовлением искусственных гнезд (дупел и т. д.). Таким образом, увеличенное птичье население, как доказали опыты в лесах СССР и Польши, привело к уменьшению населения насекомых в размере почти 70%; для полного понимания функции птичьего населения в лесу нужны основательные и систематические биоценологические исследования и экологическое исследования определенных пород птиц (групп), а именно в их естественной среде. Вот, где проявляется важность и значение лесных заповедников.

В случае вреда, нанесенного птицами в лесу, необходимо исследовать причину убытков (все взаимные отношения вредных насекомых), потому что это одна, но не единственная деятельность птиц. При воспитании, образовании лесников нужно обращать их внимание на важность познания, ознакомления с функциями птичьего населения ; ознакомиться с птичьим населением как с интегральной частью целого, которое представляет собою все лесное животное общество и смотреть на лес и с точки зрения типологии как на общество растений и животных, как на целое.