ERDÉSZETI KUTATÁSOK

AZ ERDÉSZETI
TUDOMÁNYOS INTÉZET
KÖZLEMÉNYEI
1974. VOL. 70. II. KÖTET

СООБЩЕНИЯ НАУЧНО-
ИССЛЕДОВАТЕЛЬСКОГО
ИНСТИТУТА ЛЕСНОГО
ХОЗЯЙСТВА ВЕНГРИИ
1974. ВОЛ. 70. II. ТОМ

PROCEEDINGS
OF THE HUNGARIAN FOREST
RESEARCH INSTITUTE
1974. VOL. 70. II. PART

MITTEILUNGEN
DES UNGARISCHEN INSTITUTS
FÜR FORSTWISSENSCHAFTEN
1974. VOL. 70. II. BAND

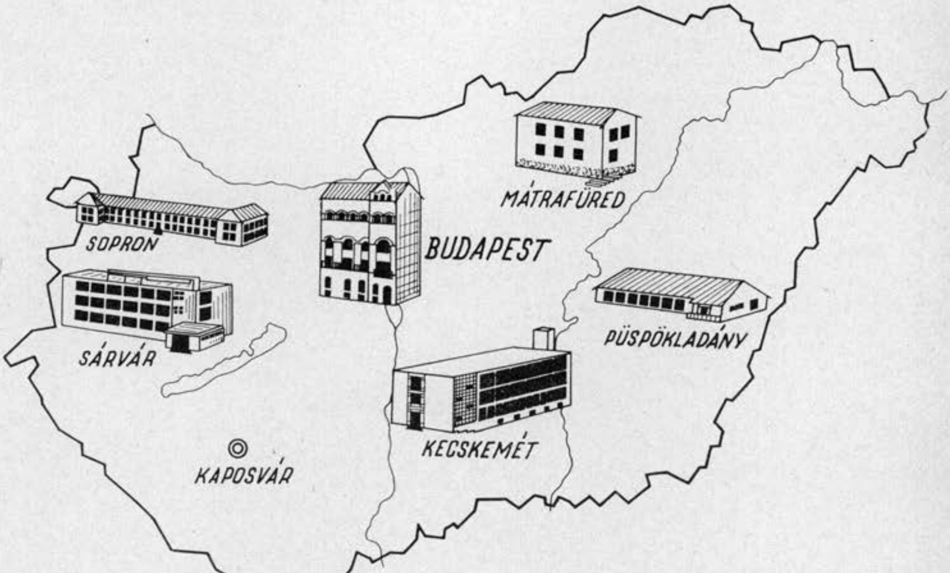
ERDÉSZETI KUTATÁSOK

ERDÉSZETI TUDOMÁNYOS INTÉZET
BUDAPEST

НАУЧНО-ИССЛЕДОВАТЕЛЬСКИЙ ИНСТИТУТ ЛЕСНОГО
ХОЗЯЙСТВА ВЕНГРИИ, БУДАПЕШТ

FOREST RESEARCH INSTITUTE
BUDAPEST

INSTITUT FÜR FORSTWISSENSCHAFTEN
BUDAPEST



KÍSÉRLETI ÁLLOMÁSOK

ОПЫТНЫЕ СТАНЦИИ

RESEARCH STATIONS

VERSUCHSSTATIONEN

SOPRON
SÁRVÁR
KAPOSVÁR

MÁTRAFÜRED
PÜSPÖKLADÁNY
KECSKEMÉT

ERDÉSZETI KUTATÁSOK

AZ ERDÉSZETI TUDOMÁNYOS INTÉZET KÖZLEMÉNYEI

СООБЩЕНИЯ НАУЧНО-ИССЛЕДОВАТЕЛЬСКОГО ИНСТИТУТА ЛЕСНОГО ХОЗЯЙСТВА ВЕНГРИИ

PROCEEDINGS OF THE HUNGARIAN FOREST RESEARCH INSTITUTE

MITTEILUNGEN DES UNGARISCHEN INSTITUTS FÜR FORSTWISSENSCHAFTEN

1974. (VOL. 70.) № 2.

IDEGEN NYELVŰ SZÁM

ИЗДАНИЕ НА ИНОСТРАННЫХ ЯЗЫКАХ

FOREIGN LANGUAGE EDITION

FREMDSPRACHIGE AUSGABE

BUDAPEST — БУДАПЕШТ

1974

Főszerkesztő

Editor-in-chief *Chfredakteuer*

Главный ребактор

BÉLA KERESZTESI

Szerkesztőbizottság

Editorial board *Redaktionskollegium*

Редакционная коллегия

ZOLTÁN JÁRÓ, HUBERT PAGONY, REZSŐ SOLYMOS, TIBOR SZÁSZ, LÁSZLÓ SZEPESI

Felelős szerkesztő

Responsible editor *Verantwortlicher Redakteur*

Ответственный редактор

CSABA MÁTYÁS

DER EINFLUSS VON FORSTSCHÄDLINGEN AUF DIE SORTIMENTS-STRUKTUR

GYÖRGY LENGYEL–HUBERT PAGONY

1. EINLEITUNG

Der potentielle Wert der Koniferenbestände des Landes wird von den verschiedenen biotischen und abiotischen Schädlingen bzw. Schäden sowie von der eventuellen Unfachmässigkeit der Bewirtschaftung grundsätzlich beeinflusst. Die Grösse dieses Einflusses kannten wir bisher nicht. Wir wünschten daher mit Hilfe der Analyse von Versuchsflächen konkrete Daten in bezug auf die folgenden Fragen zu erhalten:

1. In welchem Anteil kommen die einzelnen Kategorien der Schäden vor?
2. In welchem Verhältnis steht die Zahl der gesunden Stämme zur gesamten Stammzahl?
3. Wie gross ist der Anteil des von Krankheiten betroffenen Holzvolumens?
4. In welchem Masse und in welcher Verteilung vermindern die Schäden und Schädlinge den Wert der lebenden Holzmasse?

Wir analysierten ferner auf Grund früherer Untersuchungsergebnisse die Möglichkeiten einer allgemeinen Verbesserung des Gesundheitszustandes der Bestände und das Mass in dem die vorausgesetzte Verbesserung des Gesundheitszustandes den Stammholzausbeuteprozentsatz beeinflusst.

Die Erhebungen im Gelände wurden von der Gemeinschaft der Forstschutzforscher und -techniker des Instituts für Forstwissenschaften (ERTI) durchgeführt.

2. UNTERSUCHUNGSMETHODE

Die Zahl der erhobenen, 0,2 ha grossen und nach Wuchsgebiets- und Altersgruppen verteilten Versuchsflächen betrug in den Beständen der Gemeinen Kiefer 80, der Schwarzkiefer 48 und der Fichte ebenfalls 48. Die Erhebung erfolgte in einer vierfachen Wiederholung. Auf allen Parzellen wurden in der ersten Altersgruppe je 100, in der zweiten je 200, in der dritten und vierten sämtliche Bäume bemessen. Die Erhebung der Bäume erfolgte durch die Bestimmung des Wertanteils der aus ihnen im Hiebsalter voraussichtlich anfallenden Sortimente (Sortimentsgruppen). Als 100 prozentig wurden jene Bäume bewertet, aus denen es, unabhängig vom gegenwärtigen Alter, im Hiebsalter voraussichtlich möglich sein wird, Gerüstholz oder Sägeholz I. oder II. Klasse herzustellen. Den darauf bezogenen prozentualen Wertanteil der einzelnen Sortimentsgruppen berücksichtigten wir bei der Erhebung in der folgenden Weise:

Sortimentsgruppe:			
Gerüstholz	3—6 m	14∅	100%
Sägeholz Klasse I. und II.			
II. Sortimentsgruppe:			
Sägeholz Klasse III.	3—6 m		
Abschnitt	0,5—	18∅	60%

III. Sortimentsgruppe:			
Schleifholz	1—2 m	10—35	
(für Papier)		Zopf—∅	40%
IV. Sortimentsgruppe:			
Faserholz (für Faser- u. Spanplatten)	1 m	3—25 ∅	30%
V. Sortimentsgruppe:			
Für industrielle Beartung ungeeignetes Brennholz	1 m	5 ∅	20%.

Die Bewertung des Einzelbaumes erfolgte nach der durch das höchstwertige Sortiment bestimmten Sortimentsgruppe.

Die Erhebung der Versuchsflächen erfolgte auf einheitlichen Formularen. Im Erhebungsprotokoll wurden die Einzelbäume grundsätzlich danach verteilt, ob ihre Erhaltung unter der Berücksichtigung ihres Zustandes bzw. des im Bestande eingenommenen Platzes voraussichtlich bis zur Endnutzung möglich ist oder ob sie in kurzer Zeit eingeschlagen werden müssen. Die nach dem langfristig möglichen Hiebsalter bewerteten Bäume sind mit dem verbleibenden Bestand nahezu identisch. Dagegen sind die Bäume, deren Bewertung nur nach dem gegenwärtigen Zustand möglich ist und auf deren Höhen- und Dickenwachstum man im Leben des Bestandes nicht rechnen kann, annähernd mit dem ausscheidenden Bestand identisch.

Je nach Versuchsfläche errechneten wir aus der Grundfläche und den hergestellten Höhenkurven die Gesamtholzmasse je Hektar und gesondert die Holzmasse der schädigungsfreien Stamme. Der Schwerpunkt unserer Untersuchungen lag auf der Analyse der Kiefernbestände der Altersgruppe III. und IV. In der Tabelle 1. sind die Daten der Stammzahl und Holzmasse je Hektar dieser Versuchsflächen zusammengefasst, mit eingerechnet den Anteil nach Stammzahl und Holzmasse der gesunden und kranken Bäume. Wir hielten es nicht für zweckmässig, diese eingehende Untersuchung auch bei den Schwarzkiefern- und Fichtenbeständen durchzuführen, da diese infolge der kleineren Zahl der Versuchsflächen zu einer genügend sicheren Bewertung nicht ausreichen.

Das Verfahren der Sortimentsplanung nach Abmessungsgruppen (nach *Dérföldi* und *Szász*) ermöglicht auf Grund des mittleren Durchmessers die Einschätzung des Sägeholzausbeuteprozentsatzes. Die bearbeiteten Daten beziehen sich auf zufällig ausgewählte Bestände. Darum lassen sich die Daten unserer gegenwärtigen, ebenfalls zufällig ausgewählten Versuchsflächen auf demselben Niveau vergleichen. Die Daten der Sortimentsplanung nach Abmessungsgruppen entsprechen daher im Mittel dem durchschnittlichen Gesundheitszustand der jetzt erhobenen Versuchsflächen.

Wir durchführten Modellberechnungen, um zu erfahren, wie sich der Sägeholzausbeuteprozentsatz in den einzelnen Abmessungsgruppen geändert haben würde, wenn es sich nicht um Bestände mittlerem Gesundheitszustandes, sondern um Bestände ganz gesunder Bäume gehandelt hätte. Der Rechengang war der folgende:

In der Abmessungsgruppe IV. (17—24 cm) erhöhten wir das Sägeholzprozent
mit 20% des Bearbeitungsholzes
mit 100% des Grubenholzes
mit 40% des Schleifholzes
mit 20% des Faserholzes
mit 20% des sonstigen Nutzholzes
mit 20% des Brennholzes,

Tabelle 1. Stammzahl- und Holzmassendaten der Versuchsflächen der gemeinen Kiefer

Altersgruppe III.

Nr. der Vers. fläche	Mittl. $d_{1,3}$ (cm)	Stammzahl St/ha		%-Anteil der gesunden Stämme	Holzmasse fm/ha			%-Anteil der gesunden Holzmasse	%-Anteil der kranken Holzmasse
		gesamte	davon gesund		gesamte	gesunde	kranke		
1	2	3	4	5	6	7	8	9	10
9	21	710	30	4	205	6	199	3	97
14	12	2 135	—	—	192	—	192	—	100
19	19	680	365	54	198	110	88	56	44
28	20	1 110	95	9	363	29	334	8	92
31	22	1 100	110	11	469	41	428	8	92
32	25	490	85	17	257	40	217	16	84
40	13	1 425	805	57	124	73	51	59	41
41	18	1 405	1 195	85	316	276	40	87	13
43	13	1 495	125	8	134	16	118	12	88
48	11	1 000	130	43	65	12	53	18	22
55	17	955	390	41	174	67	107	38	62
57	15	1 505	505	34	250	111	239	44	56
58	14	1 180	310	26	145	39	106	27	73
61	15	1 385	390	28	209	72	137	34	66
62	19	630	200	32	165	55	110	33	67
73	16	1 260	660	52	223	131	92	59	41
74	15	1 320	645	49	183	111	72	61	39
75	16	1 410	510	36	254	109	145	43	57
76	19	625	275	44	159	71	88	45	55
29	10	5 805	895	15	424	96	328	23	77
59	10	1 790	490	27	104	33	71	32	68
Altersgruppe IV.									
1	39	280	270	96	303	299	4	98	2
2	24	850	585	69	392	305	87	78	22
3	25	620	315	51	306	165	141	54	46
4	18	895	345	39	187	85	102	45	55
13	22	815	25	3	282	12	270	4	96
15	22	720	15	2	176	7	169	4	96
20	24	700	380	54	310	191	119	62	38
30	33	430	45	10	472	52	420	11	89
39	34	275	100	36	290	113	177	39	61
44	29	315	50	16	214	49	165	23	77
56	15	1 340	490	37	191	76	115	40	60
60	14	1 605	455	28	198	64	134	32	68
63	14	1 625	345	21	186	52	134	27	73
77	24	640	160	25	287	95	192	33	67
79	24	635	255	40	277	112	165	40	60
80	26	810	300	37	468	182	286	39	61
Durchschnitt		42 660	12 645	29,6	9 361	3 494	5 867	37,3	62,7

Tabelle 2. Errechnung des Sägeholzausbeuteprozents nach Abmessungsgruppen

$d_{1,3}$		Verteilung (Landesmittel)				Idealisierte Verteilung				Differenz der Sägeholzausbeute (%) (idealisierte Landesmittel)
	1	IV.	V.	VI.	Summe	IV.	V.	VI.	Summe	
	2	Sägeholzprozent				Sägeholzprozent				
	3	38,7	66,5	78,7	—	54,4	95,5	100	—	
		Br. Derbholzmasse %—Sägeholzausbeute %				Br. Derbholzmasse %—Sägeholzausbeute %				
1	2	3	4	5	6	7	8	9	10	11
10	2	20,0	—	—	—	20,0	—	—	—	—
	3	7,7	—	—	7,7	10,9	—	—	10,9	3,2
11	2	29,6	0,1	—	—	29,6	0,1	—	—	—
	3	11,5	0,1	—	11,6	16,1	0,1	—	16,2	4,6
12	2	37,4	0,4	—	—	37,4	0,4	—	—	—
	3	14,5	0,3	—	14,8	20,3	0,4	—	20,7	5,9
13	2	45,5	0,8	—	—	45,5	0,8	—	—	—
	3	17,6	0,5	—	18,1	24,8	0,8	—	25,6	6,5
14	2	50,5	1,5	—	—	50,5	1,5	—	—	—
	3	19,5	1,0	—	20,5	27,5	1,4	—	28,9	7,4
15	2	55,5	2,8	—	—	55,5	2,8	—	—	—
	3	21,5	1,9	—	23,4	30,2	2,7	—	32,9	9,5
16	2	59,5	4,8	0,1	—	59,5	4,8	0,1	—	—
	3	23,0	3,2	0,1	26,3	32,4	4,6	0,1	37,1	10,8
17	2	62,7	7,3	0,2	—	62,7	7,3	0,2	—	—
	3	24,3	4,9	0,2	29,4	34,1	7,0	0,2	41,3	11,9
18	2	65,2	10,0	0,3	—	65,2	10,0	0,3	—	—
	3	25,2	6,7	0,2	32,1	35,5	9,6	0,3	45,4	12,3
19	2	66,3	13,3	0,4	—	66,3	13,3	0,4	—	—
	3	25,7	8,8	0,3	34,8	36,1	12,7	0,4	49,2	14,4
20	2	67,5	16,5	0,4	—	67,5	16,5	0,4	—	—
	3	26,1	11,0	0,3	37,4	36,7	15,8	0,4	52,9	15,5
	1	38,7	66,5	78,7	—	54,4	95,5	100,0	—	—
21	2	67,5	20,0	0,5	—	67,5	20,0	0,5	—	—
	3	26,1	13,3	0,4	39,8	36,7	19,1	0,5	56,3	16,5
22	2	67,1	23,2	0,7	—	67,1	23,2	0,7	—	—
	3	26,0	15,4	0,6	42,0	36,5	22,2	0,7	59,4	17,4
23	2	65,2	27,0	0,9	—	65,2	27,0	0,9	—	—
	3	25,2	18,0	0,7	43,9	35,5	25,8	0,9	62,2	18,3
24	2	63,3	30,5	1,0	—	63,3	30,5	1,0	—	—
	3	24,5	20,3	0,8	45,6	34,4	29,1	1,0	64,5	18,9
25	2	60,8	34,0	1,3	—	60,8	34,0	1,3	—	—
	3	23,5	22,6	1,0	47,1	33,1	32,5	1,3	66,9	19,8
26	2	57,1	38,0	1,9	—	57,1	38,0	1,9	—	—
	3	22,1	25,3	1,5	48,9	31,1	36,3	1,9	69,3	20,4

(Fortsetzung Tabelle 2.)

$d_{1,3}$		Verteilung (Landesmittel)				Idealisierte Verteilung				Differenz der Sägeholzausbeute (%) (idealisierte Landesmittel)
	1	IV.	V.	VI.	Summe	IV.	V.	VI.	Summe	
	2	Sägeholzprozent				Sägeholzprozent				
	3	38,7	66,5	78,7	—	54,4	95,5	100	—	
		Br. Derbholzmasse %—Sägeholzausbeute %				Br. Derbholzmasse %—Sägeholzausbeute %				
1	2	3	4	5	6	7	8	9	10	11
27	2	52,8	42,3	2,7	—	52,8	42,3	2,7	—	—
	3	20,4	28,1	2,1	50,6	28,7	40,4	2,7	71,8	21,2
28	2	47,0	47,5	3,8	—	47,0	47,5	3,8	—	—
	3	18,2	31,6	3,0	52,8	25,6	45,4	3,8	74,8	22,0
29	2	41,6	51,8	5,1	—	41,6	51,8	5,1	—	—
	3	16,1	34,4	4,0	54,5	22,6	49,5	5,1	77,2	—
30	2	37,5	54,2	6,8	—	37,5	54,2	6,8	—	—
	3	14,5	36,0	5,4	55,9	20,4	51,8	6,8	79,0	23,1
31	2	33,5	56,5	8,6	—	33,5	56,5	8,6	—	—
	3	13,0	37,6	6,8	57,4	18,2	54,0	8,6	80,8	23,4
32	2	30,0	58,9	9,8	—	30,0	58,9	9,8	—	—
	3	11,6	39,2	7,7	58,5	16,3	56,2	9,8	82,3	23,8
33	2	26,9	60,3	11,5	—	26,9	60,3	11,5	—	—
	3	10,4	40,1	9,1	59,6	14,6	57,6	11,5	83,7	24,1
34	2	24,1	61,8	13,1	—	24,1	61,8	13,1	—	—
	3	9,3	41,1	10,3	60,7	13,1	59,0	13,1	85,2	24,5
35	2	21,9	62,4	15,0	—	21,9	62,4	15,0	—	—
	3	8,5	41,5	11,8	61,8	11,9	59,6	15,0	86,5	24,7

in der Abmessungsgruppe V. (25—34 cm) erhöhten wir das Sägeholzprozent
mit 100% des Bearbeitungsholzes
mit 100% des Schleifholzes
mit 75% des Faserholzes
mit 50% des sonstigen Nutzholzes
mit 50% des Brennholzes,
in der Abmessungsgruppe VI. (über 35 cm) zogen wir die gesamte Industrieholzmasse als mögliches Sägeholz in die Rechnung.

Die ursprünglichen und die modifizierten (idealisierten) Sägeholzprozente gestalteten sich nach Durchmessergruppen in der folgenden Weise

Durchmessergruppe	IV.	V.	VI.
ursprüngliches Sägeholzprozent	38,7	66,5	78,7
idealisiertes Sägeholzprozent	54,4	95,5	100,0.

In Bezug auf den durchschnittlichen Gesundheitszustand sowie auf den idealisierten Zustand errechneten wir eingehend die Sägeholzausbeuteprozente und ihre Differenzen und führten diese in Tabelle 2. nach dem durchschnittlichen Brusthöhendurchmesser verteilt nach.

3. UNTERSUCHUNGSERGEBNISSE, FOLGERUNGEN

3.1 Der Anteil des Vorkommens der einzelnen Schadenarten

Wir untersuchten das Verhältnis der Zahl der von den verschiedenen Schadenarten betroffenen Bäume zur Gesamtzahl der auf den Versuchsflächen erhobenen Bäume. Bei dieser Bewertung wünschten wir nur die Zahlenverhältnisse zu klären und befassten uns nur später mit dem Wertminderungseffekt der Schädigungen.

Nach den in der Tabelle 3. angeführten Angaben erhoben wir die Daten von rund 15 000 Bäume der gemeinen Kiefer. Nur 29% der Stämme wurden als schadenfrei angesprochen. Auf nahezu der Hälfte (47%) der Bäume liess sich die Schädigung von Evetria feststellen. Der Anteil der unterdrückten oder starke Seitenzweige aufweisenden Bäume belief sich auf 12%. Die von Fomes annosus befallenen Bäume waren mit 3% vertreten. Die eingehende Analyse der Daten in bezug auf die wichtigeren Schädlinge ermöglichte verschiedene Folgerungen.

Der Anteil der von Evetria befallenen Bäume zeigte nach Altersgruppen keine grössere Unterschiede (50, 54, 42, 41%). Dies bedeutet, dass sich der Anteil infolge der Reinigungen und Durchforstungen kaum veränderte.

Die waldbaulichen Fehler (unterdückte, astige Bäume) erscheinen mit dem grössten Anteil in den 21 bis 40 jährigen Beständen was auf eine allgemeine Vernachlässigung der Pflegehiebe schliessen lässt.

Die von Fomes betroffenen 3% der Stammzahl verdienen eine grössere Aufmerksamkeit, da sich die Anwesenheit des Schadenerregers nicht auf die momentan betroffenen Bäume beschränkt, sondern auf den Infektionsgrad der Bestände hinweist und auf das allmähliche Absterben der nahestehenden Bäume schliessen lässt. Es soll hier der südtransdanubische Wuchsbezirk hervorgehoben werden, wo 13% der 21 bis 40 jährigen Bäume von Fomes annosus befallen waren. Der Wurzelschwammbefall ist auch deshalb beachtenswert, weil die befallenen Bestände schon vorweg nicht das sonst übliche Hiebsreifealter erreichen können.

Die Daten der Tabelle 4. zeigen die Verteilung der erhobenen 7787 Schwarzkiefernstämme nach ihrem Gesundheitszustand bzw. den Schadfaktoren. 58% der Stämme sind gesund. Das ist eben das zweifache im Vergleich zu dem, was man bei der gemeinen Kiefer feststellte. Von den Schadenarten herrschen bei der Schwarzkiefer Evetria und die waldbauliche Unfachmässigkeit vor, aber ihr Anteil überschreitet in keinem Falle 16%.

Auch 7 211 Fichtenstämme wurden erhoben (Tabelle 5), 59% sind gesund. Es sei der 16 prozentige Anteil der vom Wild beschädigten Stämme hervorzuheben. Mit einem ähnlichen Anteil (15%) sind die Stämme vertreten, die wegen der starken Seitenastbildung an Wert verloren haben. Nahezu 4% der Bäume sind von Fomes annosus befallen. Dies betrifft die Bestände über 21 Jahren. Besonders beunruhigend ist der Infektionsanteil in Süd-Transdanubien. Hier sind 33% der über 41 Jahre alten Stämme befallen.

3.2 Die von Krankheiten und Schäden betroffene Holzmasse

Eine eingehende Untersuchung dieser Frage zeigte sich nur in den Altersgruppen II. und IV. der Kiefer als zweckmässig. Die ausführlichen Daten sind in der Tabelle 1. enthalten.

Der prozentuale Anteil der kranken Holzmasse zeigt bei der versuchsflächenweise durchgeführten Analyse eine grosse Streuung. Die extremen Werte sind 2 und 100%. Der auf Grund der Holzmasse gerechnete mittlere Wert beträgt 62,7%. Im Mittel ergeben sich

Tabelle 3. Die Zahl der in der Beständen der gemeinen Kiefer bewerteten Stämme, nach Gebiets- und Altersgruppen sowie Schadenarten verteilt

Gebietsgruppe	Altersgruppe	Nach der perspektiven Bewertung						Nach dem gegenwärtigen Zustand						Insgesamt
		Schadenfrei	Evetria	Wild	Drehrost	Raupen	Insgesamt	Unterdrückt	Wurzelschw.	Borkenkäfer	Pissodes	Abiotisch	Insgesamt	
West-Transdanubien	I.	546	304	25			875	25					25	900
	II.	42	471	31			544	56					56	600
	III.	6	542	7			555	10					10	565
	IV.	309	423	3			735	3	102				105	840
Südtransdanubien	I.	19	233	38			290	4	5			1	10	300
	II.	90	564	37			691	80	16			13	109	800
	III.	310	618	219			1 147	340	235	16	9	86	686	1 833
	IV.	85	42	9			136	59	31				90	220
Transdanub. Mittelgeb.	I.	169	142	157	1		469	13		1		28	14	511
	II.	229	311	133	44	1	718	70			1	11	82	800
	III.	348	307	2	37		694	173	3	22		4	202	896
	IV.	30	40		24		94	8	2	3			13	107
Nördl. Mittelgeb.	I.	70	298	58	22		.448							448
	II.	635	644	21			1 300	90				10	100	1 400
	III.	361	566	13	6		946	226		7		24	257	1 203
	IV.	260	429	20			709	190		2		13	205	914
Tiefland	I.	8	313	2			323	77					77	400
	II.	204	402				606	170				24	194	800
	III.	411	215	13		9	648	155	101	2	1	15	274	922
	IV.	205	147	1		89	442	65	33			15	113	555
Insges.	I.	812	1 290	280	23		2 405	119	5	1		29	154	2 559
	II.	1 200	2 392	222	44	1	3 859	466	16		1	58	541	4 400
	III.	1 436	2 248	254	43	9	3 990	904	339	47	10	129	1 429	5 419
	IV.	889	1 081	33	24	89	2 216	325	168	5		28	526	2 642
Gesamtsumme		4 337	7 011	789	134	99	12 370	1 814	528	53	11	244	2 650	15 020
Prozentverteilung		29	47	5	1	1		12	3	1		1		100

Tabelle 4. Die Zahl der in den Schwarzkieferbeständen bewerteten Stämme, nach Gebiets- und Altersgruppen sowie Schadenarten verteilt

Gebietsgruppe	Altersgruppe	Nach der perspektiven Bewertung						Nach dem gegenwärtigen Zustand						Gesamtsumme
		Schadenfrei	Evetria	Wild	Drehrost	Raupen	Insgesamt	Unterdrück	Wurzelschw.	Borkenkäfe	Pissodes	Abiotisch	Insgesamt	
Süd-Transdanub.	I.	203	95	101			399				1		1	400
	II.	633	266	4		2	905	64		2		29	95	1000
	III.	428	97				525	382	43			17	442	967
	IV.	476	115	2			593	185	34			22	241	834
Transdanub. Mittelgeb.	I.	81	25	94			200							200
	II.	931	38	112		1	1 082	177	36				213	1295
	III.	84	98	1	46		229	94				19	113	342
	IV.	382	16	8			406	14	1			12	27	433
Tiefland	I.	249	62	8	4		323	70				7	77	400
	II.	465	158	8	1		632	116	41	4		7	168	800
	III.	308	156	1	44		509	137				34	171	680
	IV.	264	107		3	15	389	32	4			11	47	436
Insges.	I.	533	182	203	4		922	70			1	7	78	1000
	II.	2029	462	124	1	3	2 619	357	77	6		36	476	3 095
	III.	820	351	2	90		1 263	613	43			70	726	1 989
	IV.	1122	238	10	3	15	1 388	231	39			45	315	1 703
Gesamtsumme		4504	1 233	339	98	18	6 192	1 271	154	6	1	158	1 595	7 787
Prozentverteilung		58	16	4	1	1		16	2			2		100

Tabelle 5. Die Zahl der in den Fichtenbeständen bewerteten Stämme, nach Gebiets- und Altersgruppen sowie Schadenarten verteilt

Gebietsgruppe	Altersgruppe	Nach der perspektiven Bewertung						Nach dem gegenwärtigen Zustand						Gesamtsumme
		Schadenfrei	Evetria	Wild	Drehrost	Raupen	Insgesamt	Unterdrück	Wurzelschw.	Borkenkäfer	Pissodes	Abiotisch	Insgesamt	
West-Transdanubien	I.	353		15			368	81					81	449
	II.	375					375	146					146	521
	III.	598		307	63		973	196	5	5			206	1 179
	IV.	187		142			329	3					3	332
Süd-Transdanubien	I.													
	II.	409	55	87			551	144				5	149	700
	III.	364	6	69	12		451	114	82			18	214	665
	IV.	159		59			218	42	133			7	182	400
Nördliches Mittelgebirge	I.	555	16	102			673			48		15	63	736
	II.	608		86		94	788	177					177	965
	III.	307		144			451	148	40	35		18	241	692
	IV.	312		159			471	54	3	14		30	101	572
Insgesamt	I.	908	16	117			1 041	81		48		15	144	1 185
	II.	1 392	55	173		94	1 714	467				5	472	2 186
	III.	1 269	6	520	80		1 875	458	127	40		36	661	2 536
	IV.	658		360			1 018	99	136	14		37	286	1 304
Gesamtsumme		4 227	77	1 170	80	94	5 648	1 105	263	102		93	1 563	7 211
Prozentverteilung		59	1	16	1	1		15	4	2		1		100

daher 62,7% der Holzmasse der Bestände der Altersgruppe III. und IV. aus Stämmen, die von einem Schädling oder einer Krankheit, eventuell einem waldbaulichen Fehler betroffen worden sind und deren Stammbildung einen ungünstigen Einfluss erlitt. *Die gesunde Holzmasse der Bestände, das heisst die Grundlage der Wertholzproduktion, beläuft sich kaum auf etwas mehr als ein Drittel, auf 37,3% der Gesamtholzmasse.* Das Schätzungsverfahren nach Abmessungsgruppen enthält daher nach den Erörterungen aus Abschnitt 2 schon vorweg solche Daten der Sägeholzausbeute und der sonstigen Nutzholzausbeute, die sich i. allg. auf Bestände mit einem so grossen Anteil kranker Holzmasse beziehen. Deshalb erscheinen in den einzelnen Abmessungsgruppen zwischen den stärkeren Sortimenten die Kurzholzsortimenten bzw. das Brennholz in einen so grossen Anteil. Bei einem Vergleich des Anteils der gesunden Holzmasse je Versuchsfläche mit dem Anteil der als gesund angesprochenen Bäume bestätigte sich nur teilweise die erwartete Voraussetzung, dass die gesunden Stämme eine verhältnismässig grössere Holzmasse vertreten. In den Altersgruppen II. und IV. der Kiefer beläuft sich der Anteil der gesunden Stämme auf 29,6%, diese Stämme vertreten 37,3% der Gesamtholzmasse.

3.3 Das Mass der Wertminderung infolge von Schäden und Schädlingen

Wir analysierten die Daten der Versuchsflächen nach Wuchsgebieten und Altersgruppen, um die mittlere Wertminderung feststellen zu können, die infolge verschiedener Schadenarten bei den betroffenen Stämmen auftritt. Die Daten fassten wir für die Baumarten Kiefer, Schwarzkiefer und Fichte und für sämtliche Altersgruppen nach Gebietsgruppen verteilt in den Tabellen 6., 7. und 8. zusammen.

Aus Tabelle 6. ist es ersichtlich, dass der wichtigste Schädling der Kiefernbestände *Rhyacionia (Evetria) buoliana* ist. Die von diesem Schädling verursachte Wertminderung ist für die Stammbildung ausschlaggebend. In den Beständen unter 40 Jahren beläuft sich die Wertverminderung der beschädigten Stämme im Landesdurchschnitt auf 45 bis 50%; in den älteren Beständen ist dieser Anteil etwas kleiner (37%). Die Analyse nach Gebiets- und Altersgruppen zeigt, dass die grösste Abweichung vom erwähnten Landesmittel in den Jungbeständen unter 10 Jahren des Grossen Ungarischen Tieflandes besteht. Die Intensität der Schädigung ist hier so gross, dass die mittlere Wertverminderung der beschädigten Stämme 61% beträgt.

Die vom Wilde verursachte Wertminderung der Stämme beträgt im Landesmittel bis zum Alter von 40 Jahren mehr als 30%. Die Wertminderung der in den älteren Beständen zurückgebliebenen wildbeschädigten Stämme ist bedeutend kleiner (19%), wahrscheinlich darum, weil man bei den Pflegehieben die stärker beschädigten Stämme entfernte. Es sei hier besonders die grosse (50 bis 64 prozentige), das Landesmittel überschreitende Wertverminderung zu betonen, die in der Gebietsgruppe West-Transdanubien, in den 11 bis 40 Jahre alten Beständen nachgewiesen worden ist. In den mehr als 41 Jahre alten Beständen überschreitet auch hier die Wertminderung das Landesmittel nicht. Es wäre zu empfehlen, parallel mit dieser Erscheinung auch die Lage der Hochwildwirtschaft zu untersuchen.

In der Spalte „Waldbauliche Fehler" sind einerseits die unterständigen Bäume, andererseits die Stämme mit sperringen Seitenästen sowie die Protzen angeführt. Die Ursache ihrer Wertminderung ist in der Unsachmässigkeit der Bewirtschaftung zu suchen. Der Wertminderungsprozent der Stämme ist überraschend hoch, besonders in den 11 bis 40 jährigen Beständen.

Die Schädigung der Wurzelpilze, besonders des Wurzelschwammes (Fomes annosus) lässt sich auf einer stets grösseren Fläche feststellen. Die Landesangaben über die Wertminderung

Tabelle 6. Prozentsatz der in Beständen der gemeinen Kiefer wegen Schädigungen eingetretenen mittleren Wertminderung nach Gebiets- und Altersgruppen in bezug auf Waldsortimente

Gebietsgruppe	Altersgruppe	Schädigungsfreie Bäume	Evetria	Wildverbiss	Drehrost	Raupen, Afterraupen	Waldbaufehle	Wurzelpilz	Borkenkäfer	Pissodes	Abiotische Schäden	Bestandesmittel
		%										
1	2	3	4	5	6	7	8	9	10	11	12	13
West-Transdanubien	I.	∅	33	28								19
	II.	∅	34	50			53					44
	III.	∅	45	64			69					46
	IV.	∅	43	22			12	35				27
Süd-Transdanubien	I.	2	47	44			36	20			20	43
	II.	24	56	50			73	26	13	27	39	54
	III.	29	47	32			55	72	20		39	45
	IV.	19	39	22			58	72				43
Transdanub. Mittelgeb.	I.	18	36	26	16		28		16			38
	II.	12	57	38	16		53				26	42
	III.	17	45	35	11		63	20	19		15	40
	IV.	10	20		16		42	10	33			30
Nördl. Mittelgeb.	I.	∅	49	16	3							44
	II.	∅	43	17			14				19	26
	III.	∅	43	29	25		56		27		56	33
	IV.	∅	42	40			58		40		45	33
Tiefland	I.	∅	61	38			80					64
	II.	22	49				73				52	48
	III.	36	45	29		23	69	38	20	20	54	48
	IV.	24	43	10		23	58	53			38	39
Insgesamt	I.	4	45	30	4		29	4	3		4	42
	II.	12	50	31	3		53	5	3	5	27	43
	III.	18	45	38	7	5	62	26	17	4	33	42
	IV.	11	37	19	3	5	46	34	7		17	34

der Stämme zeigen es klar, dass die grössere Wertminderung in den Beständen über 41 Jahren eintritt. Die Zunahme des Krankheitserregers wird durch die 26 prozentige Wertminderung gezeigt, die in den Beständen im Alter von 21 bis 40 Jahren besteht. Nach Gebietsgruppen getrennt besteht die schlechteste Lage in Süd-Transdanubien, wo sogar die Bestände unter 10 Jahren bedeutende Schäden erlitten haben. Die Erhebungsdaten der Versuchsflächen zeigen es noch nicht, doch bei den Forschungsarbeiten wurde es schon beobachtet, dass eine ähnliche Erscheinung auch schon im Grossen Ungarischen Tiefland und im Sandgebiet Nyírség feststellbar ist.

Tabelle 7. Prozentsatz der in den Schwarzkiefernbeständen wegen Schädigungen eingetretenen mittleren Wertminderung nach Gebiets- und Altersgruppen in bezug auf Waldsortimente

Gebietsgruppe	Altersgruppe	Schädigungsfreie Bäume	Evetria	Wildverbiss	Drehrost	Raupen Afterraupen	Waldbaufehler	Wurzelpilz	Borkenkäfer	Pissodes	Abiotische Schäden	Bestandesmittel
		%										
1	2	3	4	5	6	7	8	9	10	11	12	13
Süd-Transdanubien	I.	2	61	68						20		29
	II.	4	39	30		19	60	20			40	16
	III.	10	34		10		73	35			58	18
	IV.	17	35	20			51	23			66	33
Transdanubisches Mittelgebirge	I.	∅	36	34								14
	II.	24	49	41		∅	52	12	13		13	41
	III.	6	21	∅	24		74				39	47
	IV.	19	15	3			22	13			17	22
Tiefland	I.	38	69	17	14		80				38	51
	II.	47	60	33	15		58	20	40		56	57
	III.	44	53	15	15		67				70	52
	IV.	27	51		20	18	60				15	36
Insgesamt	I.	13	55	40	5		27			7	13	31
	II.	25	40	35	5	6	57	17	18		36	38
	III.	20	36	5	16		71	12			56	49
	IV.	21	34	8	7	6	44	12			33	30

Die Tabelle 7. zeigt in bezug auf die Bestände der *Schwarzkiefer* die allgemeine Wertminderung der von den einzelnen Schadenarten betroffenen Stämme. Es sei zu bemerken, dass in den Gebietsgruppen West-Transdanubien und Nördliches Mittelgebirge keine versuchsweise Datenerhebung erfolgte, da die Schwarzkiefer hier mit einem verhältnismässig niedrigen Anteil vertreten ist. Auf der geprüften Fläche ist die grosse wertmindernde Wirkung von *Rhyacionia buoliana* auffallend, da sie in der ersten Altersgruppe sogar die Daten über die gemeine Kiefer überschreitet (55%). Die vom Wilde verursachte Wertminderung ist in den über 21 Jahre alten Beständen im Vergleich zur Weisskiefer gering (5 bis 6%). Es sei jedoch die Wertminderung zu beachten, die in den Beständen unter 10 Jahren Süd-Transdanubiens besteht.

Die an der Schwarzkiefer durch waldbauliche Fehler verursachte Wertminderung ist ebenso gross wie bei der gemeinen Kiefer. Die Schadenerregung der Wurzelpilze ist auch in den Schwarzkiefernbeständen bedeutend und beachtenswert.

In Tabelle 8. fassten wir die Erhebungsdaten über den Gesundheitszustand der *Fichtenbestände* zusammen. Von den Schadenarten verursachen die Wildschäden eine hervorragend hohe Wertminderung. Besonders in den mehr als 11 Jahre alten Fichtenbeständen ist die durch Verbiss und Schälen verursachte Wertminderung bedeutend. In den mehr als 11 Jahre

Tabelle 8. Prozentsatz der in den Fichtenbeständen wegen Schädigungen eingetretenen mittleren Wertminderung nach Gebiets- und Altersgruppen in bezug auf Waldsortimente

Gebietsgruppe	Altersgruppe	Unbeschädigte Bäume	Chermes	Wildverbiss, Stammschäden	Drehrost	Raupen Afterraupen	Waldbauliche Fehler	Wurzelpilze	Borkenkäfer	Pissodes	Abiotische Schäden	Bestandesmittel
		%										
1	2	3	4	5	6	7	8	9	10	11	12	13
West-Transdanubien	I.	Ø		50			47					17
	II.	Ø					56					24
	III.	2		10	2		52	19	19			15
	IV.	3		7			48		12			8
Süd-Transdanubien	I.											
	II.	12	36	50			69				45	33
	III.	16	10	36	9		57	17			59	29
	IV.	11		39			33	31			53	29
Nördliches Mittelgebirge	I.	Ø	Ø	10					22			3
	II.	Ø		33		10	45					21
	III.	2		49			62	23	21		35	37
	IV.	3		45			55	25	37		44	26
Insgesamt	I.	Ø	Ø	20			16		7			7
	II.	4	12	28	4	3	57				15	34
	III.	7	3	32			57	20	13		31	27
	IV.	6		30			45	19	16		32	63

alten Beständen der Fichte ist die Wertminderung der Stämme wegen Verbiss und Schälung besonders bedeutend. Ebenfalls in den über 11 Jahre alten Beständen zeigt sich die *unfachmässige Behandlung, bzw. die Versäumung der Ästung im jungen Alter als ein bedeutender Faktor der Qualitätsminderung*. Bei den Erhebungen mussten wir die starke Seitenastbildung als einen bedeutenden qualitätsmindernden Faktor betrachten aus dem Gesichtspunkt des Wertes der aus den Stämmen anfallenden Sortimente. Dadurch lässt sich die bei den Stämmen der 11 bis 40 Jahre alten Beständen nachgewiesene 57%-ige Wertminderung erklären.

Tabelle 8 enthält beachtenswerte Daten über die durch den Wurzelschwamm (Fomes annosus) in den über 20 Jahre alten Fichtenbeständen verursachte Qualitätsminderung. Der Schaden betrifft vor allem Süd-Transdanubien.

Die abiotischen Schäden vermindern bei allen drei Baumarten den Wert der Stämme wesentlich. Auffallend ist der Unterschied zwischen der Fichte und den Pinus-Arten. Bei der ersten zeigt sich eine grössere Wertminderung nur in den mehr als 21 Jahre alten Beständen, bei den letzteren erleiden die Bestände schon nach dem Alter von 11 Jahren grosse Schäden. Die Empfindlichkeit der einzelnen Baumarten gegenüber dem Schneedruck und Schneebruch lässt sich daher zahlenmässig beweisen.

Tabelle 9. Prozentuale Verteilung der in den Beständen der gemeinen Kiefer wegen Schädlingen eingetretenen Wertminderung unter den Schadenarten je Gebiets- und Altersgruppen in bezug auf die Waldsortimente

Gebietsgruppe	Altersgruppe	Unbeschädigte Bäume	Evetria	Wildverbiss, Stammschäden	Drehrost	Raupen Afterraupen	Waldbauliche Fehler	Wurzelpilze	Borkenkäfer	Pissodes	Abiotische Schäden	Insgesamt
		%										
1	2	3	4	5	6	7	8	9	10	11	12	13
West-Transdanubien	I.	∅	77	23								100
	II.	∅	78	7			15					100
	III.	∅	70	3			27					100
	IV.	∅	75	1			∅	24				100
Süd-Transdanubien	I.	∅	69	11			17	2			1	100
	II.	5	64	7			16	5	∅	∅	3	100
	III.	12	43	3			21	19	∅		2	100
	IV.	18	18	5			35	24				100
Transdanubisches Mittelgebirge	I.	12	28	45	3		11		1			100
	II.	4	43	32	7	∅	11				3	100
	III.	26	29	∅	12		29	∅	3		1	100
	IV.	12	46		24		10	1	7			100
Nördl. Mittelgeb.	I.	∅	77	22	1							100
	II.	∅	85	3			11				1	100
	III.	∅	64	2	1		27		2		4	100
	IV.	∅	59	3			36		1		1	100
Tiefland	I.	∅	75	1			24					100
	II.	12	50				33				5	100
	III.	30	24	3		1	21	15	1	∅	2	100
	IV.	22	33	∅		11	18	11			5	100
Insgesamt	I.	2	66	20	1		10	1	∅		1	100
	II.	4	64	10	1	∅	17	1	∅	∅	2	100
	III.	14	46	2	3		25	7	1	∅	2	100
	IV.	10	47	2	5		21	12	2		1	100

Wir untersuchten auch *den Anteil der einzelnen Schadenarten an der gesamten Wertminderung* der Bestände, um dadurch die Schadenart nachweisen zu können, deren wirtschaftliche Auswirkung überwiegend ist.

Bei der *Kiefer* (Tabelle 9.) ist es ersichtlich, dass im Landesdurchschnitt $^2/_3$ der Wertminderung infolge von Schädlingen in den weniger als 20 Jahre alten Beständen vom Kieferntriebwickler verursacht wird. In den über 21 Jahre alten Beständen ist dieser Anteil noch immer hoch, 46 bzw. 47 %. Dies zeigt, dass der Evetriabefall unserer Bestände nicht neu ist. Besonders beachtenswert ist die Vorherrschung von Evetria als Schadfaktor (75,77 %) bei den Bäumen der Bestände unter 10 Jahren. In den jüngeren Beständen ist der Anteil der Wildschäden, in den Baumhölzern der der waldbaulichen Fehlern gross. Es sei zu erwähnen, dass sich in den älteren Beständen der Schadenanteil von Fomes annosus auf mehr als 10% beläuft.

In den *Schwarzkiefernbeständen* (Tabelle 10.) ist die Schadwirkung von Evetria im vergleich zur gemeinen Kiefer wesentlich kleiner. Der hohe Schadenteil der waldbaulichen Fehler ist vor allem die Folge der starken Seitenastbildung der Schwarzkiefer.

Die Wertminderung unserer Fichtenbestände (Tabelle 11.) ist vor allem den Wildschäden und der Versäumung der Ästungen (den waldbaulichen Fehlern) zuzuschreiben.

4. DIE BEZIEHUNG ZWISCHEN GESUNDHEITSZUSTAND UND SÄGEHOLZAUSBEUTE

Es wurde im Abschnitt über die Untersuchungsmethode schon erörtert, dass die gegenwärtig gültigen Grundtabellen der Sortenplanung nach Abmessungsgruppen durchschnittlich solchen Beständen entsprechen, deren Holzmasse nur zu 37,3% aus gesunden, schädigungsfreien Bäumen besteht. Die diesbezüglichen prozentualen Daten der Sägeholzausbeute sind in Spalte 6 der Tabelle 2. nach mittleren Brusthöhendurchmessern enthalten. Die im Abschnitt Methodik behandelten und auf 100 prozentig gesunde Bäume idealisierten Säge-

Tabelle 10. Prozentuale Verteilung der in den Beständen der Schwarzkiefer wegen Schädlingen eingetretenen Wertminderung unter den Schadenarten je Gebiets- und Altersgruppen in bezug auf die Waldsortimente

Gebietsgruppe	Altersgruppe	Unbeschädigte Bäume	Evetria	Wildverbiss, Stammschäden	Drehrost	Raupen, Afterraupen	Waldbauliche Fehler	Wurzelpilze	Borkenkäfer	Pissodes	Abiotische Schäden	Insgesamt
		%										
1	2	3	4	5	6	7	8	9	10	11	12	13
Süd-Transdanubien	I.	2	49	48						1		100
	II.	9	48	1		1	18	3		20		100
	III.	12	10		9		59	8		2		100
	IV.	44	15	1			35	2		3		100
Transdanubisches Mittelgebirge	I.	∅	64	36								100
	II.	33	17	15		∅	18	17	∅		∅	100
	III.	4	24	∅	19		45				8	100
	IV.	66	6	2			7	1			18	100
Tiefland	I.	46	21	2	1		28				2	100
	II.	49	22	1	∅		20	6	1		1	100
	III.	29	32	∅	4		28				7	100
	IV.	41	36		1	5	12				5	100
Insgesamt	I.	16	45	29	∅		9			∅	1	100
	II.	30	29	6	∅	∅	19	9	∅	7	∅	100
	III.	15	22	∅	11		44	3		∅	5	100
	IV.	50	19	1	∅	2	18	1		1	8	100

holzausbeuteprozente gaben wir in der Spalte 10 der Tabelle 2. an. Wenn man die Werte z.B. mit den Daten dess 22 cm grossen mittleren Brusthöhendurchmessers in Proportion stellt, so lassen sich die folgenden Erwägungen machen.

Im 37,3 prozentig gesunden Bestand beträgt die Rundholzausbeute 42%, im 100 prozentig gesunden Bestand beträgt die idealisierte Rundholzausbeute 59,4%.

Eine 62,7%-ige Verbesserung des Gesundheitszustandes kann daher eine Erhöhung des Sägeholzausbeuteprozents um 59,4—42,0= 17,4% bedeuten.

Durch eine Verbesserung des Gesundheitszustandes um 1% lässt sich daher im Prinzip eine Erhöhung des Sägeholzausbeuteprozents um $\frac{17,4}{62,7} = 0,28\%$ erreichen.

In der weiteren prinzipiellen Ableitung rechneten wir statt Holzmassenproportionen mit der Proportion der von den einzelnen Schadenarten betroffenen Stämme. (Da die Errechnung der Holzmassendaten nach Schadenarten eine Arbeit bedeutet hätte, die im Verhältnis zum erzielten Ergebnis unverhältnissmässig gross gewesen wäre, haben wir davon abgesehen.)

In Tabelle 3. wurde nachgewiesen, dass z.B. im Falle der gemeinen Kiefer im Mittel etwa 50% der Stämme von Evetria beschädigt werden. Wenn man gegen diesen Schädling über eine wirksame Bekämpfungstechnologie verfügen würde und durch ihre Anwendung die von Evetria verursachten Schäden um ein Drittel (auf 16%) zurückdrängen könnte, so könnte man

Tabelle 11. Prozentuale Verteilung der in den Beständen der Fichte wegen Schädlingen eingetretenen Wertminderung unter den Schadenarten je Gebiets- und Altersgruppen in bezug auf die Waldsortimente

Gebietsgruppe	Altersgruppe	Unbeschädigte Bäume	Chermes	Wildverbiss, Stammschäden	Drehrost	Raupen, Afterraupen	Waldbauliche Fehler	Wurzelpilze	Borkenkäfer	Pissodes	Abiotische Schäden	Insgesamt
		%										
1	2	3	4	5	6	7	8	9	10	11	12	13
West-Transdanubien	I.	Ø		45			55					100
	II.	Ø					100					100
	III.	7		35	2		54	1	1			100
	IV.	21		55			20		4			100
Süd-Transdanubien	I.											
	II.	23	9	19			48				1	100
	III.	36	1	13	6		29				6	100
	IV.	25		21			19				4	100
Nördliches Mittelgebirge	I.	Ø	Ø	50					50			100
	II.	Ø		20		25	55					100
	III.	Ø		35			48	8	3		6	100
	IV.	7		54			21	1	7		10	100
Insgesamt	I.	Ø	Ø	47			28		25			100
	II.	8	3	13		9	66				1	100
	III.	14	Ø	28	3		44	6	1		4	100
	IV.	18		43			20	11	4		4	100

den mittleren Gesundheitszustand der Bestände auf 37,3+ 16,0= 53,3% erhöhen. Dieser Umstand könnte in dem als Beispiel gebrachten Bestand mit 22 cm mittlerem Brusthöhendurchmesser das Sägeholzprozent auf 42,0+ 0,28 · 16= 46,3% erhöhen.

In den Beständen der gemeinen Kiefer erlitten im Mittel 5% der Stämme Wildschäden und sind daher von geringerem Wert. Die Schäl- und Fegeschäden könnte man durch eine richtige Jagdwirtschaft und durch die Anwendung von Schutzmitteln mindestens bis 60% beseitigen. Dies würde bedeuten, dass nur 2% der Stämme vom Wild beschädigt wären. Der Gesundheitszustand könnte daher um 3% verbessert werden und 37,3+ 3= 40,3% betragen.

Die Behandlungsfehler, vor allem die wegen der Versäumung der Ästung auftretende Grobästigkeit, verursachten bei 12% der Bäume eine Wertminderung. Die ausgedehnte Einführung der Ästung könnte im Prinzip den mittleren Gesundheitszustand der Bäume um 12% erhöhen, dieser könnte daher 37,3+ 12= 49,3% betragen.

Aus der Zusammenfassung dieser Erörterung wird es klar, dass der gegenwärtig niedrige Gesundheitsstand durch die gleichzeitige Lösung des Problems der Ästung und der Wildschäden oder sogar durch die Erarbeitung und Einführung einer nur mässig erfolgreichen Technologie zur Bekämpfung von Evetria die Erreichung eines etwa 50 prozentigen Gesundheitszustands ermöglichen könnte.

Auf Grund der nach den oben beschriebenen Prinzipien durchgeführten Rechnungen stellten wir auf Abbildung 1. die Beziehungen zwischen dem Gesundheitszustand der gemeinen Kiefer und dem Sägeholzausbeuteprozent in der Funktion des mittleren Brusthöhendurchmessers dar.

Die Abbildung zeigt für den gegenwärtigen Zustand (37%), den idealisierten Zustand (100%) und für den mit Hilfe der Versuchsergebnisse, wirtschaftlichen Massnahmen als reelle Zielsetzung geltenden 50%-igen Gesundheitszustand die errechneten Sägeholzausbeuteprozente.

Mit Hilfe der Kurven lässt sich in der Kenntnis der Landesdaten des Holzeinschlags (fm, mittl. $d_{1,3}$) die infolge von Schädigungen bzw. Unfachmässigkeit verloren gegangene

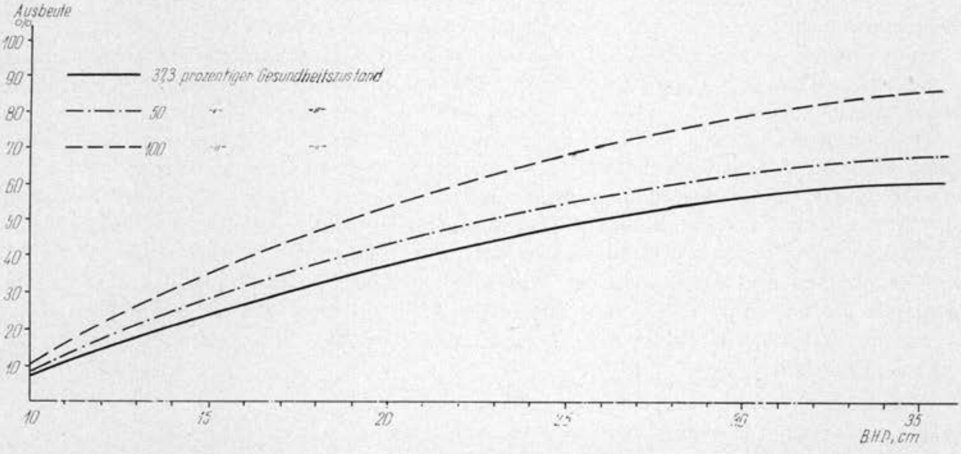


Abb. 1. Sägeholzausbeute in Prozenten in Abhängigkeit von dem mittleren Brusthöhendurchmesser und von dem Gesundheitszustand

Sägeholzmenge bewerten. Nach dieser Anschauung lassen sich der Sägeholzausfall bzw. die qualitative Wertminderung der Bestände auch für die einzelnen forstwirtschaftlichen Einheiten bewerten.

5. ZUSAMMENFASSUNG UND EMPFEHLUNGEN

Bei der Untersuchung des Gesundheitszustands der Nadelbaumbestände wurden bisher auf 176 Versuchsflächen 15 020 Stämme der gemeinen Kiefer sowie 7 787 Schwarzkiefern- und 7 211 Fichtenstämme erhoben. Gleichzeitig mit dem Gesundheitszustand der Stämme wurde auch der voraussichtliche Wert der aus den einzelnen Stämmen im Haubarkeitsalter anfallenden Sortimente bestimmt. Dies diente als Grundlage zur Übersicht der durch Schäden und Schädlinge verursachten Wertminderung. Bei der gemeinen Kiefer waren 29% der erhobenen Stämme schädigungsfrei. Bei der Schwarzkiefer und Fichte war der Anteil der schädigungsfreien Stämme 58 bzw. 59%.

Für die gemeine Kiefer errechneten wir in Bezug der Altersgruppen III. und IV. auch den Holzmassenanteil der gesunden Stämme, dieser betrug 37,3%.

Auf Grund des zahlenmässigen Anteils der Stämme bestimmten wir den Prozentsatz der Stämme, an denen die einzelnen Schadenarten vorkommen. Von diesen sind die folgenden Daten zu beachten: In den Beständen der *gemeinen Kiefer* erlitten 47% der Stämme Evetria-Schäden. Infolge einer unfachmässigen Behandlung entstandene Schäden (unterdrückte, grobastige Bäume, Protzen usw.) wurden bei 12% der Stämme, ein Fomes-Befall bei 3% der Stämme festgestellt.

In den *Schwarzkiefernbeständen* sind die Schäden mässiger. Evetria-Befall wurde bei 16%, Fomes-Befall bei 2% der Stämme festgestellt. Schäden infolge einer unsachgemässen Behandlung wurden an 16% der Stämme nachgewiesen.

In den Fichtenbeständen sind die Wildschäden mit dem grössten Anteil (16%) vertreten. Die unsachgemässe Behandlung (Versäumung der Ästung) verursachte an 15% der Stämme eine bedeutende Wertminderung. Der Anteil der Fomes-befallenen Stämme beträgt 4%.

Die Erhebungsmethode ermöglichte die Analyse des Anteils und der Verteilung der Wertminderung. Die mittlere Wertminderung variiert nach Altersgruppen. Bei der Kiefer und Schwarzkiefer beläuft sich die gesamte Wertminderung im Mittel auf etwa 40%. Bei der Fichte ist die Variation nach Altersgruppen grösser und schwankt von 7 bis 63%.

In den Beständen der gemeinen Kiefer werden 50 bis 60% der gesamten Wertminderung von Evetria, 10 bis 20% vom Wild, 10 bis 25% von waldbaulichen Fehlern bzw. von schlechten genetischen Eigenschaften, 12% von der Fomes annosus-Infektion verursacht.

Beachtenswert ist die Lage der Fichtenbestände, in denen die Wertminderung grundsätzlich auf die Wildschäden und auf die Versäumung der Astung zurückzuleiten ist.

Im Lichte der Erhebungsdaten wurden die Beziehungen zwischen dem Gesundheitszustand der Bestände und der Gestaltung des Sägeholzausbeuteprozents geprüft. Durch die Lösung des Problems der Evetria-Bekämpfung oder durch die umfangreiche Einführung der Ästungen könnte bei gleichzeitiger Lösung der Wildschadenverhütung der Gesundheitszustand der Bestände der gemeinen Kiefer vom derzeitigen 37% auf etwa 50% erhöht werden. Dies würde das Sägeholzausbeuteprozent je nach dem mittleren Brusthöhendurchmesser um 10 bis 20% erhöhen.

Adresse der Verfasser: Dr. Gy. Lengyel, Abt.-leiter, Dr. H. Pagony, Abt.-leiter,
Zentrale des Instituts für Forstwissenschaften (ERTI)
1277 Budapest 23, Pf. 17.

ДРЕВЕСНАЯ ПРОДУКЦИЯ ОРЕХА ЧЕРНОГО

ФЕРЕНЦ ПАЛОТАШ

В Венгрии 0,2% лесов государственных лесхозов занято древостоями ореха черного. Около 70% площадей, занятых древостоями ореха черного, приходится на возрастные классы ниже 30 лет. Такое распределение указывает на возрастающее использование ореха черного.

Широкое лесохозяйственное распространение древесной породы, акклиматизированной из североамериканской прародины, мимо быстрого роста, обуславливается и ее ценной древесиной. На своем местопроизрастании особи ореха черного достигают большого прироста древесины, стройного роста ствола и импозантных размеров. На прародине в долине рек Миссисипи и Охайо, в насаждении отдельные стволы достигают высоты 45 м и на высоте человека диаметра 2 м. Во Франции известно несколько исполинских деревьев ореха черного, чем несомненно подтверждается акклиматизация этой древесной породы в Европе. В долине р. Рон окружность свободно растущего дерева на высоте 2 м над уровнем земли составляет 540 см (диаметр около 172 см), длина части ствола без сучков — 9 м (Garavel, L., 1960).

Крупные особи, выявленные при учетах, подверждают, что заниматься выращиванием упомянутой древесной породы стоит и в условиях нашей страны. На пойменной почве под г. Мохач, в окрестностях с. Кёлкед, в 63-летнем древостое, на стоящем не на опушке дереве, мы нашли диаметр на высоте груди 62 см и высоту 34 м, но там же часто встречаются деревья диаметром более 50 см.

Полученные в нашей стране данные подтверждают, что на соответствующем местопроизрастании орех черный пригоден для повышения древесной продуктивности, рентабельности лесов. Однако, для того, чтобы его выращивание осуществлялось рационально, требуется изучение его требований и свойств. Среди свойств самым важным вопросом оказываются требования древесной породы к местопроизрастанию, и в связи с этим, вопрос количества и качества древесной продукции.

МЕТОД И МАТЕРИАЛ ИСПЫТАНИЙ

Наша работа по съемке данных в более широких рамках проводилась в лесохозяйственном районе поймы нижнего течения Дуная. В целях получения сравнительных данных, мы посетили несколько древостоев ореха черного в лесохозяйственном районе горного хребта Бараня—Шомодь—Толна.

Для разработки приложенной *таблицы хода роста ореха черного* мы пользовались методом расчета и выравнивания с помощью геометрической прогрессии, разработанным *Мадяром* (Magyar, 1940). Поле, затронутое таблицей хода роста, методом геометрической прогрессии мы разделили на 6 частей, образовав шесть классов бонитета.

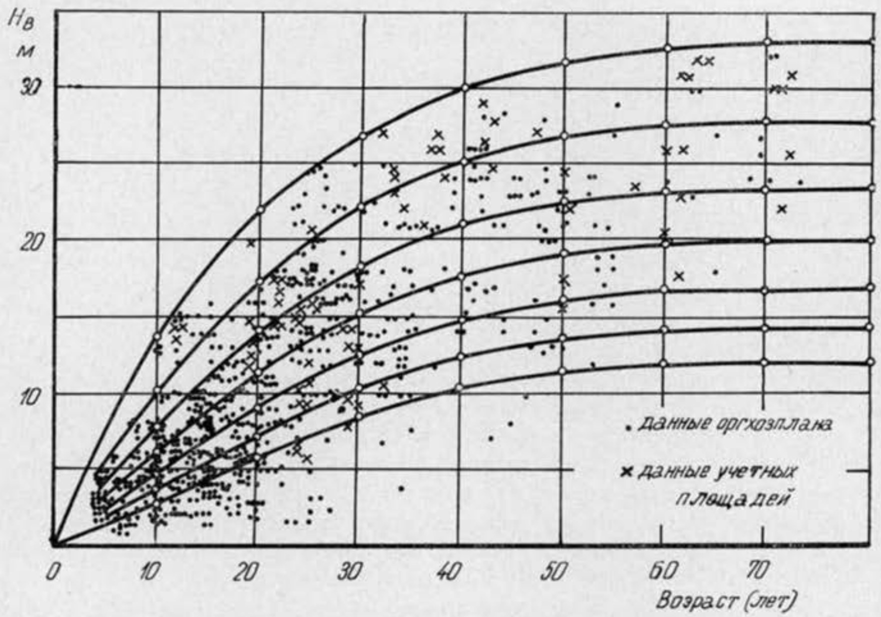


Рис. 1. Предельные кривые 6 классов таблицы хода роста ореха черного в зависимости от верхней высоты и возраста. Размещение древостоев ореха черного в поле рассеивания высоты

Исчисление *массы древесины* нами выполнено с помощью массовых таблиц ореха черного *Шопа* (Sopp, 1970). Данные хода роста охватывали общую надземную массу древесины. Основанием разработки таблицы хода роста послужили 98 модельных площадей хода роста собственной съемки. Кроме того, для конструирования поля рассеивания высоты, нами использованы данные оргхозпланов 699 выделов.

Имеющиеся в распоряжении многочисленные данные указывают на широкое рассеивание по местопроизрастанию древостоев ореха черного (рис. 1). Проблему представляло собой начерчение нижней предельной кривой поля рассеивания высоты. Не оказывалось целесообразным распространить таблицу на полноту встречаемости древостоев. Древостои, встречающиеся на линии и под линией нижней предельной кривой, являются лесами, стоящими не на своем местопроизрастании, расстроенными лесами. Мы поставили себе целью, чтобы нижний предел начертить там, где можно рассчитывать на сохранение древостоя в течение более продолжительного периода. Распространение таблицы на древостои, могущие зачисляться к классам бонитета V—VI, и без того обусловлены соображениями разработки таблицы. Они уже не являются хозяйственными лесами.

Выведение числовых рядов *массы древесины и площадей поперечных сеченый главного древостоя* осуществлено графически, при использовании взаимосвязей, рекомендованных *Мадяром* (Magyar, 1940). В целях проверки правильности исчисления массы древесины, мы рассматривали размещение учетной площади в поле рассеивания, затронутом таблицей хода роста (рис. 2). Данные массы древесины учетных площадей хорошо вкладываются в шесть классов бонитета, определенных на основании высот; разница не превосходит пределов ошибок, ожидаемых от таблиц хода роста.

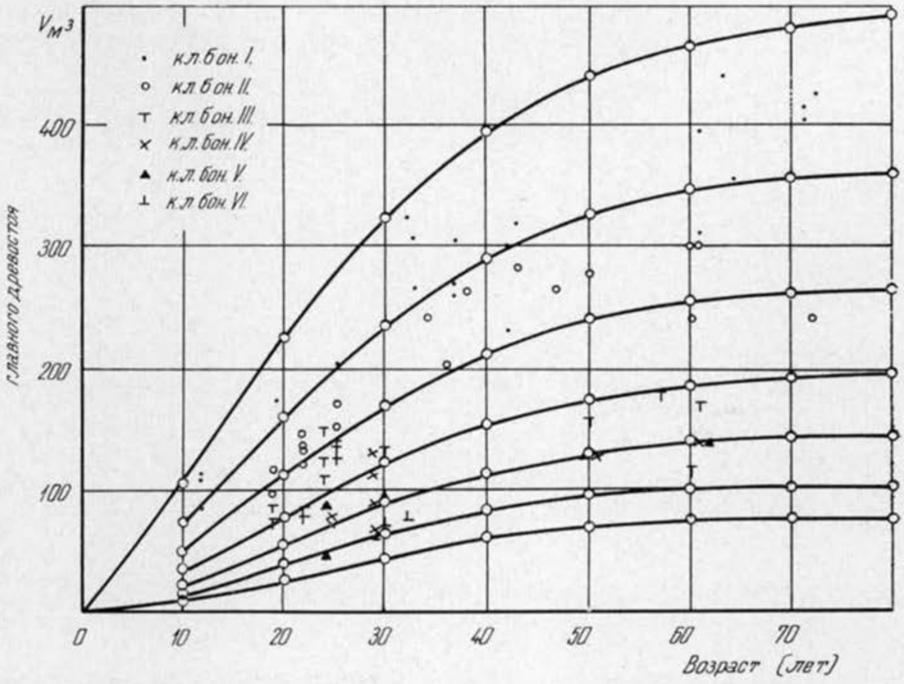


Рис. 2. — Размещение учетных площадей ореха черного в поле рассеивания геометрического разделения, затронутом таблицей хода роста

Данные *подчиненного древостоя* получены от сокращения числа стволов главного древостоя путем исчисления.

Данные *общей древесной продукции (всего древостоя)* получены путем сложения данных главного и подчиненного древостоев.

ДИСКУССИЯ

Таблица хода роста ореха черного приводится в табл. 1, а относительные числа сомкнутость-густота в табл. 2. Взаимосвязи диаметра, верхней высоты, возраста и классов бонитета в графическом изображении указаны на рис. 3.

Таблица составлена на основании однократного учета данных при использовании состояния, обнаруженного в настоящее время. Числовой ряд, выведенный на основании усреднения и указывающий ход роста, отражает средние результаты теперешних условий древостоев и он годится для оценки теперешних условий древостоев. С помощью планового и рационального ведения хозяйства изменение средних данных является возможным; приведенные в таблице средние данные также могут изменяться. Несмотря на факторы неуверенности, получаемые в результате однократного учета данных, выведенные числовые ряды в крупных чертах являются характерными для изменений факторов массы древесины, соответственно для физиологических особенностей ореха черного.

Таблица 1. Таблица роста ореха черного

Возраст	Верхняя высота H_B		Главный древостой					Подчиненный древостой			Общая древесная продукция			Возраст
	верхний	нижний	средняя высота	диаметр	площадь поперечных сечений	число стволов	масса древесины	масса древесины	сумма	Доля Σ в общей древесной продукций, в %-ах	масса древесины	прирост: средний	прирост: текущий	
	предел		H_M	$Д_{1,3}$	G	N	$V_δ$	$V_δ$	$ΣV_δ$		$V_δ$	Θ	Z	
год	м		м	см	м²	шт.	м³	м³			м³			год
1	2		3	4	5	6	7	8	9	10	11	12	13	14
Класс бонитета I														
5	6,4	4,8	5,2	4,7	7,3		41	2	2	4,65	43	8,60	8,60	5
10	13,3	10,2	11,2	10,5	11,9	1478	90	13	15	14,29	105	10,50	12,40	10
15	18,4	14,5	15,7	15,4	14,9	843	142	24	39	21,55	181	12,07	15,20	15
20	22,2	17,8	19,2	19,5	17,3	602	193	34	73	27,44	266	13,30	17,00	20
25	25,0	20,4	21,8	23,0	19,3	479	239	37	110	31,52	349	13,96	16,60	25
30	27,2	22,5	23,9	26,0	21,0	403	279	36	146	34,35	425	14,17	15,20	30
35	28,9	24,1	25,5	28,8	22,4	347	313	32	178	36,25	491	14,03	13,20	35
40	30,2	25,4	26,7	31,3	23,6	306	342	27	205	37,48	547	13,68	11,20	40
45	31,2	26,3	27,7	33,5	24,5	274	364	23	228	38,51	592	13,16	9,00	45
50	31,9	27,0	28,3	35,3	25,3	253	382	19	247	39,27	629	12,58	7,40	50
55	32,3	27,4	28,7	36,9	25,8	236	395	17	264	40,06	659	11,98	6,00	55
60	32,6	27,7	29,0	38,3	26,2	221	406	15	279	40,73	685	11,42	5,20	60
65	32,8	27,8	29,2	39,7	26,4	207	413	14	293	41,50	706	10,86	4,20	65
70	33,0	27,9	29,3	41,0	26,6	195	419	12	305	42,13	724	10,34	3,60	70
75	33,1	28,0	29,4	42,3	26,8	184	424	11	316	42,70	740	9,87	3,20	75
80	33,2	28,1	29,5	43,6	26,9	174	428	10	326	43,24	754	9,43	2,80	80
Класс бонитета II.														
5	4,8	3,6	3,9	3,5	5,9		26	2	2	7,14	28	5,60	5,60	5
10	10,2	7,9	8,5	8,1	9,8	2045	61	9	11	15,28	72	7,20	8,80	10
15	14,5	11,4	12,4	12,1	12,6	1128	99	17	28	22,05	127	8,47	11,00	15
20	17,8	14,3	15,4	15,6	14,8	794	137	24	52	27,51	189	9,45	12,40	20
25	20,4	16,7	17,8	18,8	16,7	607	171	29	81	32,14	252	10,08	12,60	25
30	22,5	18,6	19,7	21,5	18,2	500	202	28	109	35,05	311	10,37	11,80	30
35	24,1	20,1	21,3	24,0	19,4	425	229	25	134	36,91	363	10,37	10,40	35
40	25,4	21,3	22,4	26,2	20,4	374	251	22	156	38,33	407	10,18	8,80	40
45	26,3	22,2	23,3	28,2	21,2	332	269	18	174	39,28	443	9,84	7,20	45
50	27,0	22,9	24,0	29,8	21,9	304	284	13	187	39,70	471	9,42	5,60	50
55	27,4	23,3	24,4	31,3	22,3	279	293	12	199	40,45	492	8,95	4,20	55
60	27,7	23,5	24,6	32,5	22,7	262	300	11	210	41,18	510	8,50	3,60	60
65	27,8	23,6	24,8	33,7	22,9	246	305	10	220	41,90	525	8,08	3,00	65
70	27,9	23,7	24,9	34,8	23,0	231	309	9	229	42,57	538	7,69	2,60	70
75	28,0	23,8	24,9	35,9	23,1	218	312	8	237	43,19	549	7,32	2,20	75
80	28,1	23,8	25,0	37,0	23,2	205	315	7	244	43,65	559	6,99	2,00	80
Класс бонитета III.														
5	3,6	2,7	2,9	2,6	4,8		17	1	1	5,56	18	3,60	3,60	5
10	7,9	6,1	6,6	6,2	8,1	2783	42	5	6	12,50	48	4,80	6,00	10
15	11,4	9,0	9,7	9,5	10,7	1537	69	12	18	20,69	87	5,80	7,80	15
20	14,3	11,5	12,3	12,5	12,7	1027	97	18	36	27,07	133	6,65	9,20	20
25	16,7	13,6	14,5	15,3	14,4	776	123	21	57	31,67	180	7,20	9,40	25
30	18,6	15,4	16,3	17,7	15,7	625	146	22	79	35,11	225	7,50	9,00	30
35	20,1	16,8	17,7	20,0	16,8	522	167	20	99	37,22	266	7,60	8,20	35
40	21,3	17,9	18,8	22,0	17,7	450	184	18	117	38,87	301	7,53	7,00	40
45	22,2	18,8	19,7	23,8	18,4	396	199	14	131	39,70	330	7,33	5,80	45
50	22,9	19,4	20,3	25,2	18,9	362	209	11	142	40,46	351	7,02	4,20	50
55	23,3	19,8	20,7	26,5	19,3	332	217	9	151	41,03	368	6,69	3,40	55
60	23,5	20,0	20,9	27,5	19,6	312	222	8	159	41,73	381	6,35	2,60	50
65	23,6	20,1	21,0	28,5	19,7	292	226	6	165	42,20	391	6,02	2,00	65

1	2		3	4	5	6	7	8	9	10	11	12	13	14
70	23,7	20,1	21,1	29,5	19,8	273	228	6	171	42,86	399	5,70	1,60	70
75	23,8	20,2	21,1	30,4	19,9	258	230	6	177	43,49	407	5,43	1,60	75
80	23,8	20,2	21,1	31,3	20,0	243	231	6	183	44,20	414	5,18	1,40	80

Класс бонитета IV.

5	2,7	2,0	2,1	1,9	3,9		11				11	2,20	2,20	5
10	6,1	4,7	5,0	4,7	6,7	4733	28	3	3	9,68	31	3,10	4,00	10
15	9,0	7,1	7,6	7,4	9,0	2095	48	8	11	18,64	59	3,93	5,60	15
20	11,5	9,2	9,9	10,0	10,9	1339	68	14	25	26,88	93	4,65	6,80	20
25	13,6	11,1	11,8	12,4	12,4	988	88	17	42	32,31	130	5,20	7,40	25
30	15,4	12,7	13,4	14,6	13,6	779	106	17	59	35,76	165	5,50	7,00	30
35	16,8	14,0	14,7	16,7	14,6	632	122	16	75	38,07	197	5,63	6,40	35
40	17,9	15,0	15,8	18,5	15,3	538	136	13	88	39,29	224	5,60	5,40	40
45	18,8	15,8	16,6	20,0	15,9	476	147	10	98	40,00	245	5,44	4,20	45
50	19,4	16,4	17,1	21,3	16,4	431	155	8	106	40,61	261	5,22	3,20	50
55	19,8	16,8	17,5	22,5	16,7	391	160	7	113	41,39	273	4,96	2,40	55
60	20,0	16,9	17,7	23,4	17,0	365	164	6	119	42,05	283	4,72	2,00	60
65	20,1	17,0	17,8	24,2	17,1	344	167	4	123	42,41	290	4,46	1,40	65
70	20,1	17,1	17,8	25,0	17,1	324	168	4	127	43,05	295	4,21	1,00	70
75	20,2	17,1	17,9	25,7	17,2	305	169	4	131	43,67	300	4,00	1,00	75
80	20,2	17,1	17,9	26,4	17,3	289	170	4	135	44,26	305	3,81	1,00	80

Класс бонитета V.

5	2,0	1,5	1,5	1,4	3,1		7				7	1,40	1,40	5
10	4,7	3,6	3,8	3,6	5,6		19	2	2	9,52	21	2,10	2,80	10
15	7,1	5,5	5,9	5,8	7,6	2798	34	5	7	17,07	41	2,73	4,00	15
20	9,2	7,4	7,9	8,0	9,3	1725	49	9	16	24,62	65	3,25	4,80	20
25	11,1	9,1	9,6	10,1	10,7	1235	63	13	29	31,52	92	3,68	5,40	25
30	12,7	10,5	11,1	12,1	11,7	936	77	13	42	35,29	119	3,97	5,40	30
35	14,0	11,7	12,3	13,9	12,6	768	89	13	55	38,19	144	4,11	5,00	35
40	15,0	12,6	13,2	15,5	13,2	651	100	10	65	39,39	165	4,13	4,20	40
45	15,8	13,4	14,0	16,9	13,8	564	108	9	74	40,66	182	4,04	3,40	45
50	16,4	13,9	14,5	18,0	14,2	509	115	6	80	41,03	195	3,90	2,60	50
55	16,8	14,2	14,8	19,1	14,5	459	119	5	85	41,67	204	3,71	1,80	55
60	16,9	14,4	15,0	19,8	14,7	431	122	3	88	41,90	210	3,50	1,20	60
65	17,0	14,5	15,1	20,5	14,8	405	123	3	91	42,52	214	3,29	0,80	65
70	17,1	14,5	15,1	21,2	14,8	379	124	3	94	43,12	218	3,11	0,80	70
75	17,1	14,5	15,1	21,8	14,9	357	125	3	97	43,69	222	2,96	0,80	75
80	17,1	14,5	15,1	22,4	14,9	337	125	3	100	44,44	225	2,81	0,60	80

Класс бонитета VI.

5	1,5	1,2	1,1				5				5	1,00	1,00	5
10	3,6	2,8	2,9	2,7	4,6		13	1	1	7,14	14	1,40	1,80	10
15	5,5	4,4	4,6	4,5	6,4		23	4	5	17,86	28	1,87	2,80	15
20	7,4	6,0	6,3	6,4	7,9	2277	34	7	12	26,09	46	2,30	3,60	20
25	9,1	7,4	7,8	8,2	9,2	1557	45	10	22	32,84	67	2,68	4,20	25
30	10,5	8,7	9,2	9,9	10,2	1157	56	10	32	36,36	88	2,93	4,20	30
35	11,7	9,8	10,2	11,5	10,9	943	65	10	42	39,25	107	3,06	3,80	35
40	12,6	10,6	11,1	13,0	11,5	771	73	9	51	41,13	124	3,10	3,40	40
45	13,4	11,3	11,8	14,2	11,9	672	80	6	57	41,61	137	3,04	2,60	45
50	13,9	11,8	12,2	15,2	12,3	606	85	4	61	41,78	146	2,92	1,80	50
55	14,2	12,1	12,6	16,1	12,5	543	88	3	64	42,11	152	2,76	1,20	55
60	14,4	12,2	12,7	16,8	12,7	506	90	2	66	42,31	156	2,60	0,80	60
65	14,5	12,3	12,8	17,4	12,8	473	91	2	68	42,77	159	2,45	0,60	65
70	14,5	12,3	12,8	17,9	12,8	445	92	2	70	43,21	162	2,31	0,60	70
75	14,5	12,3	12,8	18,4	12,8	421	92	2	72	43,90	164	2,19	0,40	75
80	14,5	12,3	12,8	18,9	12,8	398	92	2	74	44,58	166	2,08	0,40	80

Таблица 2. Соотношение густоты и сомкнутости в насаждениях черного в Венгрии

Сомкну-тость	Густота на местопроизрастаниях I. классов	II.	III.	IV.	V.	VI.
0,1	0,1	0,1	0,1	0,1	0,2	0,2
0,2	0,2	0,3	0,3	0,3	0,3	0,4
0,3	0,4	0,4	0,4	0,5	0,5	0,6
0,4	0,5	0,5	0,6	0,6	0,7	0,8
0,5	0,6	0,6	0,7	0,7	0,9	1,0
0,6	0,7	0,8	0,8	0,9	1,0	
0,7	0,9	0,9	1,0	1,0		
0,8	1,0	1,0				

Рост насаждений ореха черного как в высоту, так и в толщину, в начале является быстрым. Рост в высоту кульминирует в возрасте 10—25 лет, рост в толщину же в возрасте 20—35 лет. Рост в высоту начиная с возраста 40—50 лет падает даже в насаждениях ореха черного, стоящих на лучших местопроизрастаниях.

Сравнение рядов данных с аналогичными данными других древесных пород не является полностью реальным. Требовательность к местопроизрастанию и биология различных древесных пород разны, но расходится и метод составления таблиц хода роста. Несмотря на это, все же целесообразным оказывается провести параллель между ростом особей дуба обыкновенного, стоящих в поймах и между ростом ореха черного, так как они встречаются вместе и насаждения ореха черного, производящие стоимости, в настоящее время стоят на хороших местопроизрастаниях дуба обыкновенного. Хорошие пойменные насаждения дуба обыкновенного представляются лучшими классами бонитета таблиц хода роста дуба обыкновенного, составленных *Р. Кишем;* приведенные в таблицах данные пригодны для сравнения (*Kiss*, 1970, 1971).

На том же, отличном, местопроизрастании орех черный в росте по высоте сначала превосходит дуб обыкновенный. Позднее, к возрасту 30—40 лет, разница выравнивается.

Орех черный — это сильно светолюбивая порода, которая нуждается в более свободном стоянии. Более быстрый начальный рост в толщину деревьев черного ореха немедленно теряется, как только кроны их начинают тесниться. Особи, выросшие в тесном стоянии, позднии, с затруднениями могут формировать свои кроны. После запоздалого нарушения сомкнутости, мы можем получить только древостои, обладающие узкой кроной, отставшие в росте по диаметру, имеющие недостаточный запас древесины.

Для целей определения по типам местопроизрастаний самой благоприятной сомкнутости древостоев, степени прореживания, однократная съемка данных является недостаточной; для этого требуется более длительное исследование. Для охарактеризования теперешнего положения, сегодняшней степени прореживания, и степени прореженности, хорошие информации предоставляются величинами $\gamma\%$, предлагаемыми *Р. Кишем* (*Kiss*, 1965). (Величина $\gamma\%$ — это стократная величина частного среднего пространства роста и верхней высоты, исчисленного из числа стволов главного древостоя.) Величины $\gamma\%$ ореха черного, исчисленные для сравне-

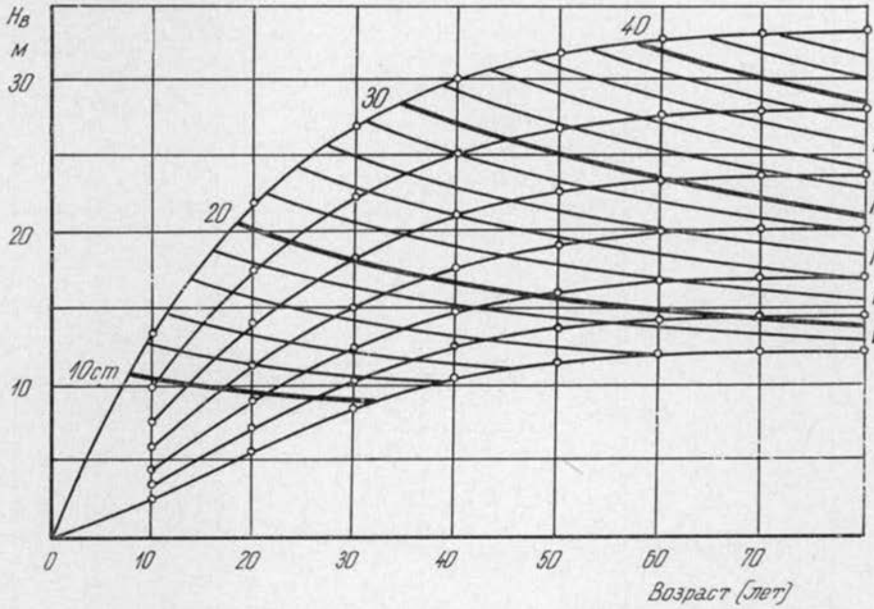


Рис. 3. — Средний диаметр главного древостоя ореха черного при фракционировании на ступени по 2 см, в зависимости от возраста, верхней высоты и классов бонитета

ния из нормативных, соответственно статистических таблиц хода роста дуба обыкновенного, составленных *Р. Кишем,* приведены на рис. 4.

В насаждениях ореха черного величины $\gamma\%$ приблизительно до возраста 50 лет постепенно снижаются, что указывает на умеренную прореженность. В возрасте более 50 лет, резкое повышение кривой указывает на снижение числа стволов, несоразмерное росту в высоту. Понижение числа стволов в насаждениях ореха черного, стоящих на местопроизрастаниях более слабых классов бонитета, обосновано пониженной древесной продуктивностью местопроизрастаний и связанной с ней гибелью стволов. Нарушение сомкнутости древостоев ореха черного в возрасте свыше 50 лет является необоснованным с точки зрения остающегося древостоя. Такое снижение числа стволов может быть сведена к причинам, скрывающимся в ведении хозяйства. Это указывает на то, что началась стоимостей из древостоя.

Схема прореживания древостоя ореха черного, выраженная в величинах $\gamma\%$, может иметь пробег, сходный с нормативной линией дуба обыкновенного, но целесообразным оказывается планирование вмешательства, более сильного на 5%.

Из-за светолюбивости и повышенной требовательности к пространству роста, целесообразным оказывается выращивать орех черный в смеси с другими древесными породами. На прародине он образует смешанные древостои с дубом, ясенем, кленом и карией. Кроме светолюбивых древесных пород, обоснованным оказывается и введение теневыносливых примесных пород. Между прочим, роль примесей заключается в способствовании биологической очистке от сучьев затенения стволов.

Разведение насаждений ореха черного становится экономичным прежде всего производством древесины пригодных для лущения размеров. Следовательно, его выращиванием стоит

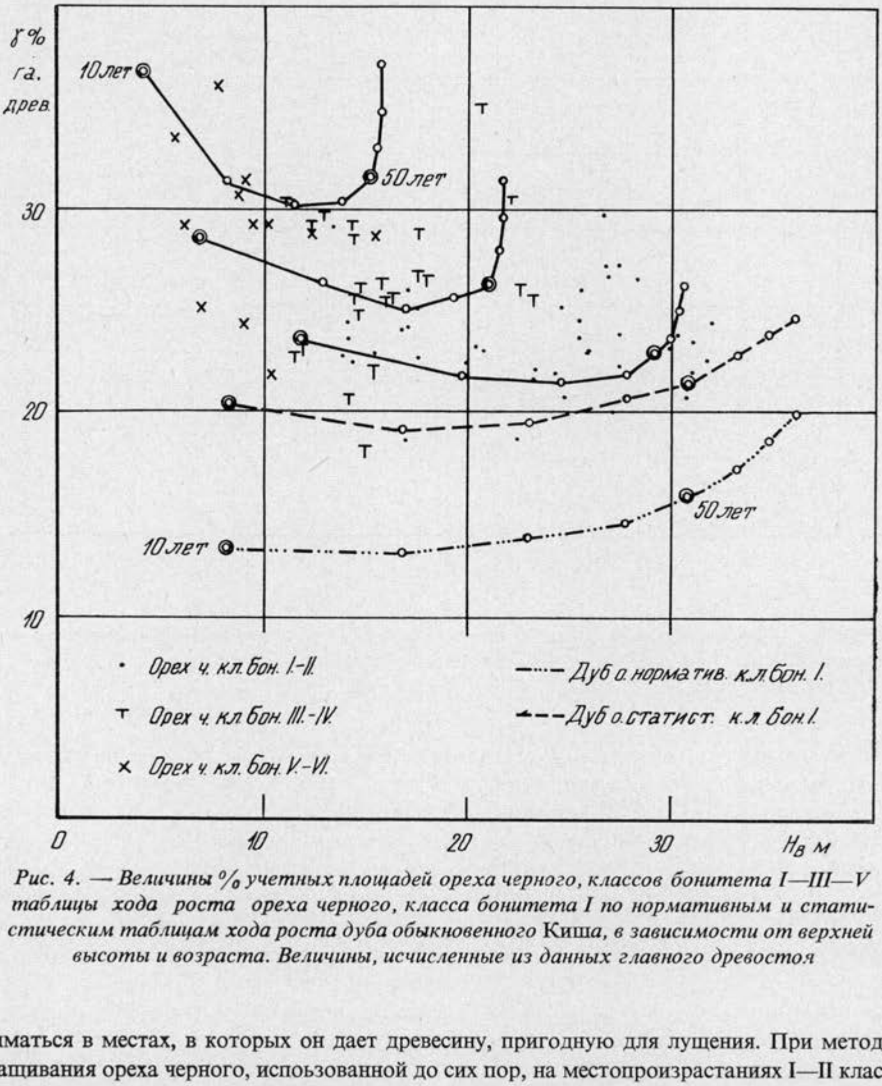


Рис. 4. — Величины % учетных площадей ореха черного, классов бонитета I—III—V таблицы хода роста ореха черного, класса бонитета I по нормативным и статистическим таблицам хода роста дуба обыкновенного Киша, *в зависимости от верхней высоты и возраста. Величины, исчисленные из данных главного древостоя*

заниматься в местах, в которых он дает древесину, пригодную для лущения. При методике выращивания ореха черного, испобзованной до сих пор, на местопроизрастаниях I—II классов бонитета к возрасту 50—70 лет средний диаметр насаждения достигает желанных 35 см. Такими местопроизрастаниями в нашей стране являются глубокие, свежие, средневысоко лежащие почвы пойм, а также наносные почвы в холмистых районах страны. Насаждения ореха черного V—VI классов бонитета не могут приниматься во внимание как насаждения, производящие стоимости, они не являются хозяйственными лесами. Производимая в них древесина достигает размеров, при которых она уже почти что может реализоваться в качестве фасонного материала.

Насаждения ореха черного широко разводились без изучения его требовательности к местопроизрастанию. На это указывает широкое поле рассеивания местопроизрастаний, указанное на рис. 1. Для того, чтобы насаждения ореха черного фактически приносили ожиданную при-

Рис. 5. — Насаждение ореха черного. Кёлкед, выдел 67а. Возраст: 71 год. Верхняя высота: 30,2 м. Класс бонитета I. Число стволов: 226 на га. Средний диаметр на высоте груди: 38,1 см. Запас древесины: 405 м³. (Фото: Палоташ)

бавочную стоимость, необходимым оказывается пересмотреть его настоящее распространение, место его использования.

Из-за отсутствия таблицы хода роста ореха черного пользовались разными таблицами хода роста. В последнее время испозовали таблицы хода роста дуба обыкновенного, разработанные *Кишем*. При пользовании таблицами хода роста дуба обыкновенного класс бонитета древостоев ореха черного сначала до возраста 30—40 лет оценивался несколько выше, в старшем возрасте же — ниже. При использовании таблиц хода роста дуба обыкновенного оценка древесной продукции также оказалась ошибочной. Количество фактической древесной продукции в возрасте свыше 50 лет, в направлении к более слабым местопроизрастаниям, уже и в более молодом возрасте было преувеличено.

ВЫВОДЫ

Лесохозяйственное использование акклиматизированного из Северной Америки ореха черного было оправдано результатами, достигнутыми в отечественных условиях. Орех черный на соответствующих его требованиям местопроизрастаниях годиться для повышения производственной стоимости наших лесов. Такими местопроизрастаниями являются у нас глубокие, свежие пойменные почвы с более высоким расположением, а также наносные почвы холмистых районов, на которых к возрасту 50—70 лет насаждения достигают размеров древесины, пригодной для лущения.

При использовании данных 98 модельных площадей хода роста и оргхозпланов 699 выделов нами составлена таблица хода роста, действительная для отечественных древостоев ореха черного. Методом геометрической прогрессии сформировано 6 классов бонитета. Ряд данных, приведенный в таблице, отражает средние результаты настоящих условий древостоев; он пригоден для оценки нынешних условий древостоев. При рациональном ведении хозяйства средние величины могут быть изменены.

Рост ореха черного сначала быстрый. Рост в высоту кульминирует в возрасте 10—25 лет, а рост в толщину в возрасте 20—35 лет.

Орех черный — светолюбивая порода, требующая более свободного стояния. Начальный быстрый рост немедленно прекращается, как только кроны начинают тесниться. Рубки ухода целесообразно закончить в период энергичного роста, до возраста 30—35 лет.

Из-за требований ореха черного к большему пространству роста, в интересах максимального использования древесной продуктивности целесообразно выращивать его в смешанных насаждениях. Роль теневыносливых пород заключается между прочим в способствовании биологической очистке сучьев.

Литература

Garavel, L. (1960): Le noyer noir d'Amérique. Revue Forestière Française, 6: 362—373.

Kiss, R. (1965): Álló fák koronaátmérőjének és gyérítettségi fokának meghatározása új viszonyszámok segítségével. (Определение диаметра кроны и степени изреженности деревьев на корню с помощью нормативных относительных чисел.) Az Erdő. 3: 126—132.

Kiss, R. (1970): Fatermési tábla a magyarországi kocsányos tölgyesekre. (Таблица хода роста древостоев дуба обыкновенного в Венгрии.) Erdészeti Kutatások. *66*: 103—114.

Kiss, R. (1971): Statisztikai fatermési tábla kocsányos tölgyesekre. Kézirat. (Статистическая таблица хода роста древостоев дуба обыкновенного. Рукопись.) Erdészeti Tudományos Intézet. Összefoglaló jelentés.

Koltay, Gy. (1961): Ártéri erdők telepítése. (Разведение пойменных лесов.) In *Magyar:* „Alföldfásítás II" Akadémiai Kiadó, Budapest, 225—293 pp.

Magyar, J. (1940): A fatermési táblák szerkesztésének alapkérdései. (Основные вопроцы составления таблиц хода роста.) Erdészeti Kutatások. *42.* 1—2: 1—105.

Rakonczay, Z.(szerk.)(1973): Erdőleltár 1970. (Инвентаризация лесов 1970. г.) MÉM Erdőrendezési Főosztály, Budapest

Sopp, L. (1970): Fatömegszámítási táblázatok. (Массовые таблицы.) Mezőgazdasági Kiadó, Budapest

Адрес автора:
Ф. Палоташ, директор
ERTI Опытная Станция
9600 Шарвар

YIELD AND IMPROVEMENT EXPERIMENTS OF DOUGLAS FIR IN HUNGARY

LAJOS HARKAI

The attention of the Hungarian experts, just like in other European countries, has been turned to the forest economical importance of Douglas fir. First of all *Pausinger* (1877) gave account of an experiment with forest economical objective and suggested the acclimatization of Douglas fir in order to increase the yield potential of beech-stands, a target that is right even today. *Bedő* (1878) wrote about *Booth*'s book, urging on experiments in our country on the basis of cultivation experiments in England, Scotland and Germany. As early as in 1880—82 some kilograms of seed was procured by the Hungarian National Forestry Association (Magyar Országos Erdészeti Egyesület) and divided among several forest offices. In 1885 the directives of acclimatization were discussed and measures were taken to organize it (*Dietz,* 1885; *Marosi,* 1885, 1886). The oldest douglas fir stands in Hungary date back to the very next decades; they are in the forests near Háromhuta, Iharosberény and Zalaegerszeg. Unfortunately, we don't know much about their origin, only that the sap-

Fig. 1. Green Douglas fir stand, Háromhuta (Photo: Michalovszky)

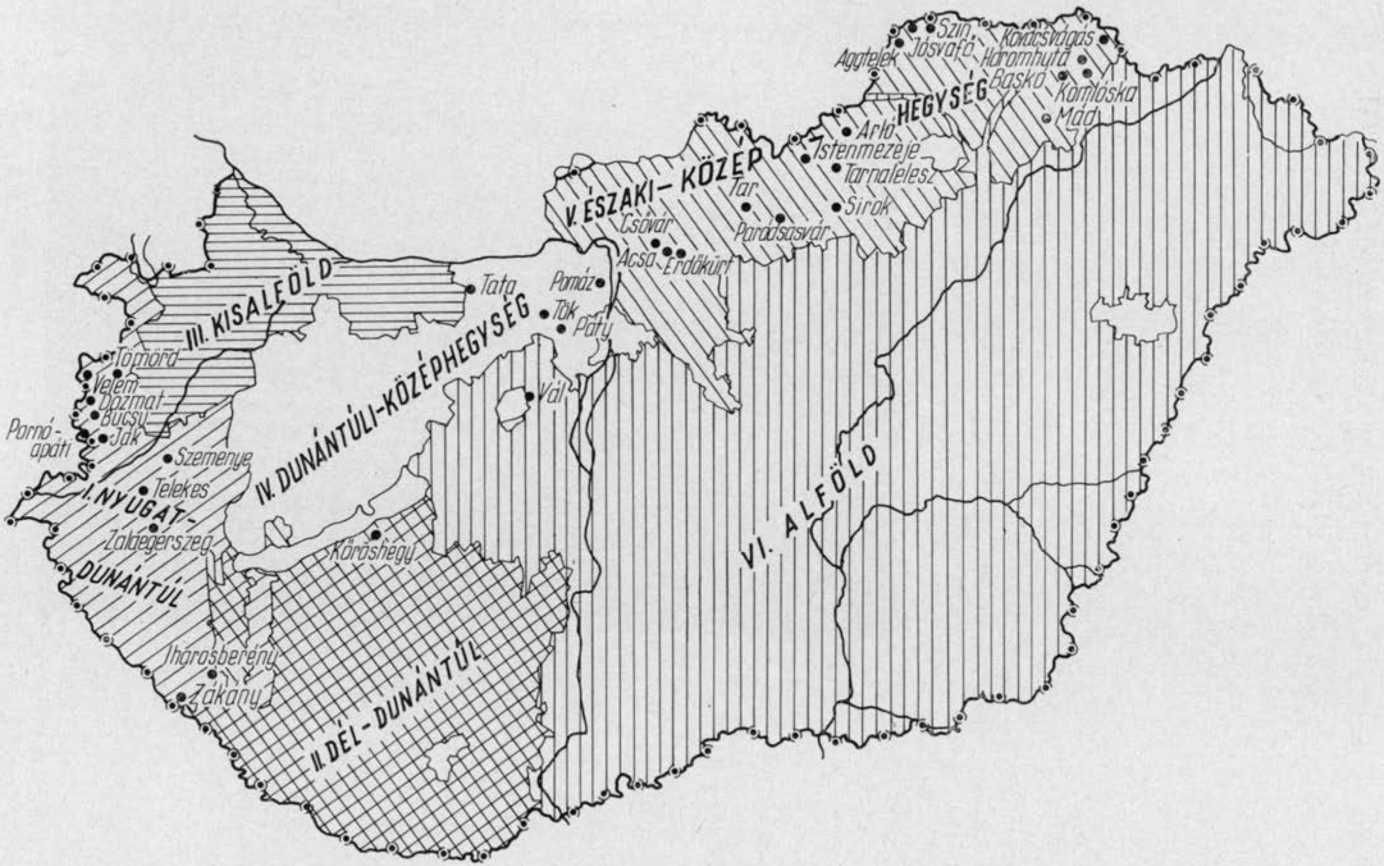


Fig. 2. Occurrences of Douglas fir in Hungary

lings of the Douglas fir stands near Háromhuta were imported by rail in careful packing from a Danish firm.

The decade between 1930 and 1940 may be taken for the second period of plantations of Douglas fir in Hungary, the third one began in the sixties.

It is the Douglas fir—out of the exotic conifers—which gave extraordinary great yields in the different regions of Europe under very dissimilar site conditions. It is of great importance in Hungary, too. Its plantation is especially rewarding in forest areas which cannot depend on the fast growing poplars because of site reasons.

Since in the course of plantation of quickly growing conifers Douglas fir is taking a prominent part in the future, it has become necessary to determine its site requirement and yield potential in Hungary. The advantage of Douglas fir is—among others—that it seems promising on sites where poplars produce less, owing to site conditions.

The Department of Afforestation and Forest Genetics of the Forest Research Institute has been investigating the stands and occurrences of Douglas fir in Hungary since 1962. On a net area of some 40 ha the data of 37 soil sections, on 73 sample plots covering, 5.55 ha the data of more that 10,000 stems were recorded. The survey of data of the stems on the sample plots was repeated every five years.

Site investigation of Douglas fir stands

In course of the examination of their *climatic requirements* the the climatic conditions of their native site were compared to those in Hungary on one hand. On the other hand, the range and growth data were compared to the climatic data of the cultivation areas.

On comparing the occurrences in Hungary to the climatic data of the respective areas, it has been stated that out Douglas fir stands generally occur on areas with annual precipitation over 600 mm and with annual average temperature lower than 10.5 °C. They cannot be found in dry lowland regions with continental climate. As for climatic requirements, Douglas fir may be planted safely on the site types of beech and hornbeam, because its humidity requirements are satisfied by them.

As for frost hardiness, it has been stated that the older stands (Háromhuta, Zemplén mountains) can bear the extremes of climate well. Only the shoots of the outermost or dominant trees or those in parks are damaged by advective frost, but this is not significant.

Juvenile frost hardiness has also been examined in order to exclude frost-sensitive types from planting. It is useful to know that among the saplings frost-sensitive, socalled "real" individuals may be marked off from more frost-hardy ones of so-called "Abies type". The former are light green, their top bud is undeveloped, the needles of the leader shoot are twisted. On the latter the needles are deeper green, the top bud is more developed and the needles are not twisted. The examination was made on saplings planted from seeds of five different provenances (Austria, G.D.R., U.S.A. and two of Hungary) by *Mrs. Nagy* (1967). On the examination the physiological, biochemical and phenotypical characteristics, reliably correlated to one another, were determined and six types of frost-hardiness were distinguished. The Lammas-shoots are characteristic of the degree and nature of frost-hardiness. By means of those the frost-resistant and frost-sensitive types may already be separated in the nursery-garden. Those not growing Lammas-shoots on their top shoots are frost-resistant and vice-versa. The percentage of frost-resistant and frost-sensitive types is characteristic of the provenance of seeds.

On examining the *influence of bedrock and configuration of terrain*, it has been stated that, if the site is suitable, douglas fir grows in hilly country (Western-Transdanubia) just as well

Table 1. Háromhuta 121 b. Sample plot I.
Exposure: North. Age: 60 years (1973)

Species	Stem number	Basal area	Volume	Mixture proportion	Volume per hectare				Average annual increment
	per 0.1 ha				mixed	pure	%		
							mixed	pure	
	pc.	m²	m³	%	m³				m³
Douglas fir	25	5.131	97.5	72	975	1354	93	83	22.5
Spruce	10	0.530	7.6	28	76	271	7	17	4.5
Total:	35	5.661	105.1	100	1051		100	100	27.0
Háromhuta 116 e Sample plot XVI. Exposure: South-West. Age: 67 years (1973)									
Douglas fir	24	3.184	50.8	34	508	1493	70	79	22.3
Silver fir	4	0.045	0.4	6	4	7			—
Spruce	1	0.020	0.2	1	2	2	1	1	—
Beech	3	0.014	0.1	4	1	2			—
Sessile oak	39	1.641	21.2	55	212	385	29	20	5.7
Total:	71	4.904	72.7	100	727		100	100	28.0

as in in the Zemplén mountains (taken for mountains on the scale of our country). As regards exposure and inclination, the results are varying. In the Zemplén mountains douglas fir stands can be found on both northern and south-western slopes, as well as on relatively plain terraces and on slopes of 15—20 degrees.

From the findings the general conclusion may be drawn that the configurations of the terrain have influence chiefly through the climatic conditions of the site.

As regards the bedrock of the native site, douglas fir stands may be found on soils coming from quite different—volcanic, sedimentary and metamorphic—origin. In Hungary stands can also be found on bedrocks as rhyolitic tuff, andesite tuff, weathered andesite, calcareous sandstone, loess, abode like loess, alluvial carbonate sand and red earth ("nyirok" soil). It has been stated that it is not the bedrock, but the soil coming from the bedrock that influences the growth decisively. This is proved by Table 2., too, where the soils coming from the bedrocks listed there, are shown on which our best Douglas fir stands grow.

On examining *the hydrological demands,* on the basis of findings in our country it may be stated that undrained, humid sites are not suitable, because Douglas fir needs air. It grows well on sites with seeping water and periodical watering, if the other site conditions are appropriate. Its growth on soils with changing moisture, i.e. on periodically pseudogley soils is dubious. It may be planted only on areas with slightly fluctuating watertable, with no aboveground water out of the sites with constant moisture. Douglas fir should not be planted on waterlogged areas or those covered with water.

On the basis of the results of the examination of *soil and nutrient requirements it* may stated that Douglas fir grows best on sandy adobe and adobe soils with good structure, with

Table 2.

Bedrock	Genetical soil type	Locality
Rhyolite tuff	hyperacid brown forest soil	Háromhuta
	podsol brown forest soil	
	brown earth	
Andesite tuff	brown earth	Parádsasvár
Weathering andesite	brown forest soil with washaway clay	
Loess-like adobe	brown forest coil with washaway clay	Iharosberény
Red earth	brown earth	Háromhuta

good water regime, and with medium deep or deep surface soil. Liability of the surface soil to crumble does not hinder growth, if it does not spoil water regime. Soils containing $CaCO_3$, or hyperacidity does not suit this species. Steady humidity of the soil is of primary importance; it is seriously injured by recurrent desiccation (reddening needles, then decay).

The analysis of needles is chiefly used for determining whether the respective tree species is satisfactorily supplied with nutrients. Such analyses have been made in the stands near Tata, Vál, Kőröshegy, Telekes, Tömörd and Parádsasvár. The correlation between the nutrients content of the soil and that of the needles is loose. At Kőröshegy the use of phosphoric fertilizer is recognizable even in the needles, just as the potassium supply at Parádsasvár. But only some slight relation seems to be between the growth of stand and the nitrogen content of the needle. From among the Kőröshegy stands the nitrogen content of the soil of those growing well is over 1%, while that of those growing less is below 1%. When all examinations are jointhly evaluated, it may be stated—though with some reservations—that according to the needle analyses the nutrient requirement of Douglas fir is higher than that of Austrian pine and nearly the same as that of spruce. Therefore the desirable nutrients percentage may be—with a slight modification—as follows:

N	1.2—1.4%
P_2O_5	0.4—0.5%
K_2O	0.5—0.7%

On the basis of our examinations it has been stated that the fallen needles of Douglas fir decompose relatively well, because on the sample plots with unmixed stands we could not see raw humus accumulating anywhere. In fact, the good nitrogen content of the surface soil proves that the needle litter of Douglas fir decomposes excellently.

In Hungary the sedimentary and alluvial soils as well as brown forest soils afford the best possibility for planting Douglas fir. In the 70 years old stand of the forest 15 c near Iharosberény, growing on sedimentary and alluvial soil, the mean height is 39 m, the average diameter 56.5 cm, the total volume 1,042 m^3/ha. In the 60 years old stand of the forest 121 b nerat Erdőhuta, growing on brown forest soil, the mean height is 37.6 m, the average diameter 45.6 cm, the total volume 847 m^3/ha.

Yield investigations of Douglas fir stands

Long range plans in tree species policy can be drawn up, the areal proportion for planting quickly growing tree species can be determined only, when not only the site requirements, but the yield potential of the tree species to be cultivated are also known.

This has necessitated to examine the yield of Douglas fir. This has been necessary also because there is no yield table for use in our country.

The survey of stands was started in 1962 by *István Bánó* (1963) in the stands near Háromhuta, Iharosberény, Istenmezeje, Komlóska, Kőröshegy, Szemenye, Tata, Telekes, Tömörd, Vál and Zalaegerszeg. On more than 50 sample plots the re-surveys were made in 1967 and 1972.

Within the stands sample plots of 0.1 ha (40× 25 m) were marked out and each stem was examined. The girth of each stem at breast height was measured and the respective diameter was recorded with cm accuracy. On the sample plots the height of 20–100 per cent of the stems were measured and the data were adjusted according the height curve. *Grundner*'s volume table for spruce was used to determine the total volume. In the course of survey condensed records were made containing the data relating to the crowns, shape of stems and health condition of the single trees.

The yield tables include the data of the sample plots on which the percentage of the volume of Douglas fir was over 60%. Since the area of the available Douglas fir stands is relatively small, the data of three quinquennial surveys were processed. The accuracy was increased by site exploration and evaluation on one hand, and by detailed analysis of felled stems on different sites, on the other hand.

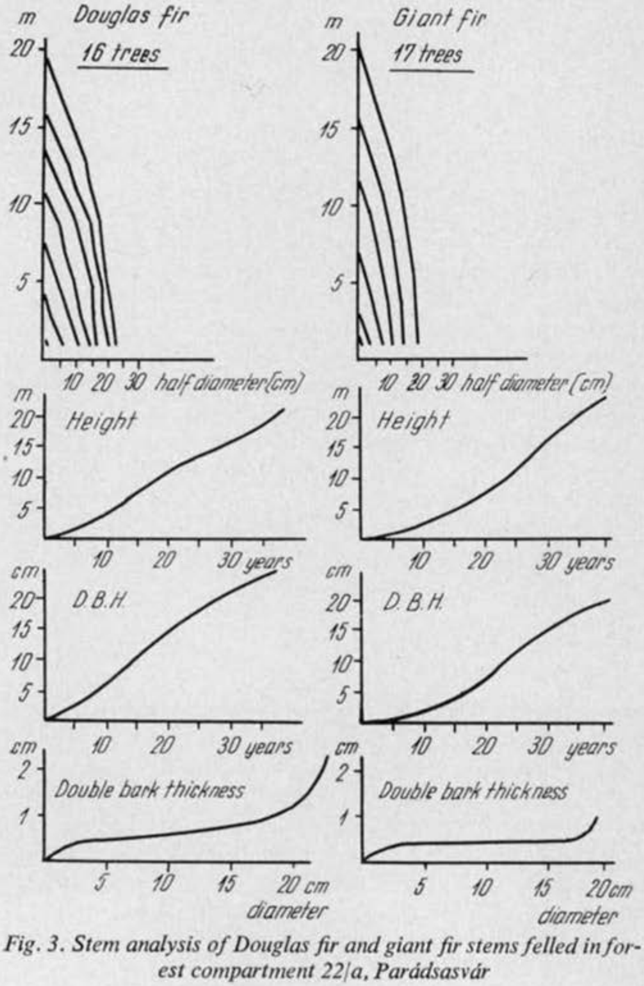


Fig. 3. Stem analysis of Douglas fir and giant fir stems felled in forest compartment 22/a, Parádsasvár

The construction of the yield table for the whole stand was started with mak-

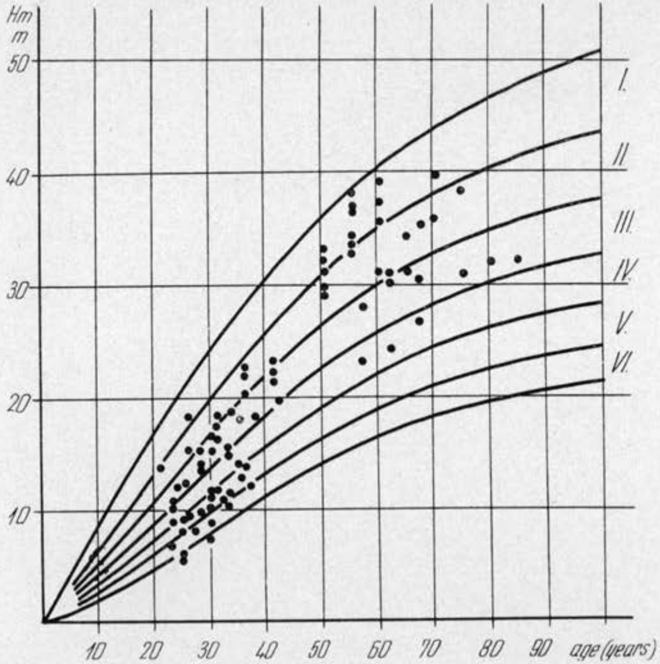


Fig. 4. Position of the sample plots in the dispersion field of mean heights

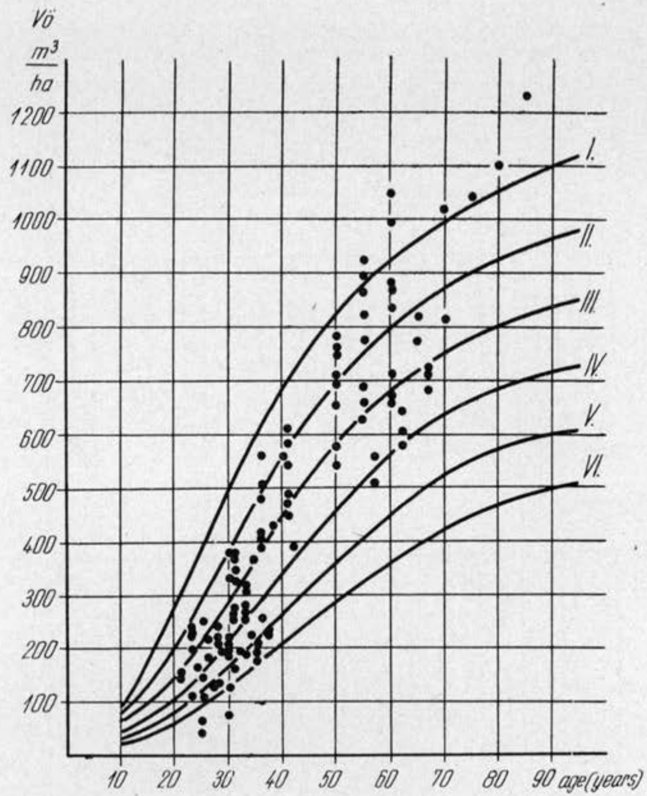


Fig. 5. Mean graphs of total volume of the whole stand

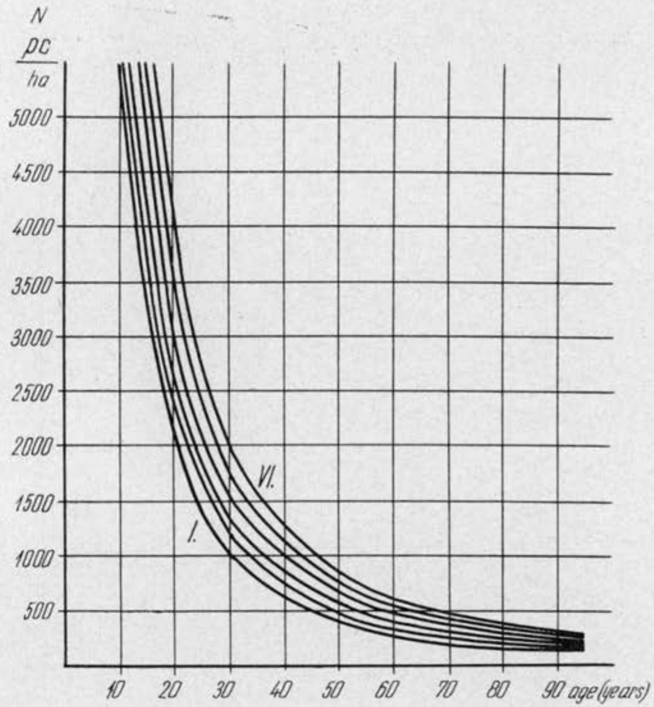


Fig. 6. Graphs of stem number of the whole stand

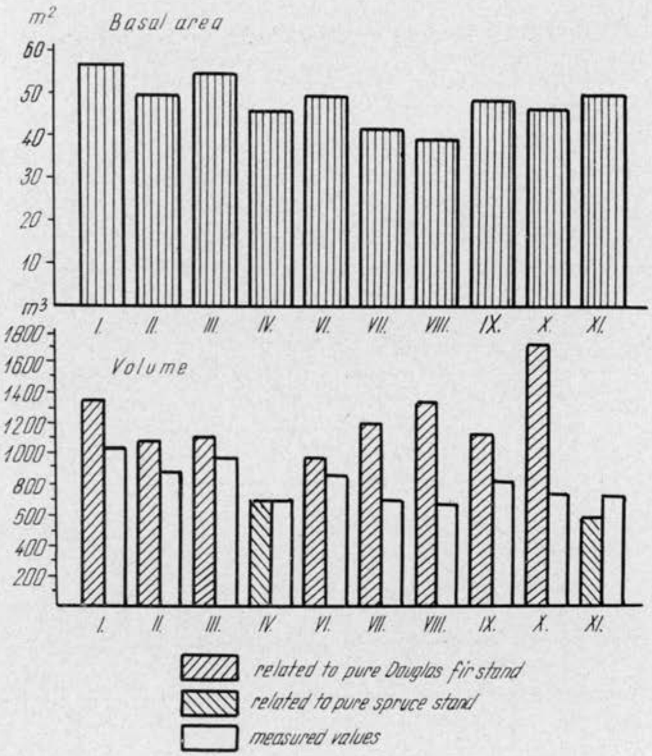


Fig. 7. Basal area and volume per ha of Douglas fir stands at the age of 60 in forest compartment 121/b, Háromhuta (Roman numbers: sample plot numbers)

ing the dispersion field of heights. The field was divided into six yield classes according to the geometrical progression method elaborated by *Magyar* (1940).

In order to determine the total volume of the whole stand, the volume data of the sample plots, divided into three classes on the basis of the site survey results, were plotted separately against the mean heights. It has turned out that most of the weighted averages of the three site classes coincide with the envelope curves. Therefore the total volume of the whole stand was calculated by means of the data series of mean heights.

The basal area was calculated by means of the formula $G=\frac{V}{HF}$. The final values were obtained with graphic adjustment.

Relationship $N=\frac{G}{g}$ was used to obtain the number of stems. The basal area per ha was divided with the basal area data calculated from the diameter and so the value series of the number of stems was obtained.

According to the evaluation on the basis of the survey the stands in the forest 121 b near Erdőhuta are of the highest value among the green Douglas fir stands in Hungary. The great yield potential of green Douglas fir is convincingly proved by the data of Fig. 7.

Most of our Douglas fir stands are mixed ones (spruce, larch, fir, white pine, as well as beech, sessile-oak, hornbeam, atc.); sometimes the proportion of Douglas fir is 20–40%, as regards the number of stems, while the proportion on the same area is 60–80% as regards volume. Out of the mixed stands the plantation mixed with Abies grandis shows the best results. The forest 22/a near Parádsasvár gives an advantageous example of this kind of mixedness, which is found in its original habitat, too.

For contrasting the yield tables made by us, the data of *Hengst*'s yield tables for Douglas fir (in *Erteld*, 1965) and those of *Solymos* for spruce (1968) were used. When comparing the data of these tables it appears that e.g. in *Hengst*'s yield table the volume of 536 m^3/ha at the age of 50 years in the I. yield class corresponds to the volume of 580 m^3/ha at the age of 50 years in the III. yield class in our yield table. It is probable that the sites in our country are of a better quality and this is the reason for the difference. Therefore foreign tables are unsuitable for conditions in our country.

We compared our data with those in *Solymos*'s yield tables for spruce, because some of our sample plots are on the areas with the best spruce plantations in Hungary, in fact they are mixed with it. The volume of the whole stand is 691 m^3/ha at the age of 50 years in the I. yield class of spruce, while that of Douglas fir is 814 m^3/ha.

Improvement of Douglas fir

The beginning of improvement activities aiming at improving the quality, increasing the quantity of wood, as well as sees growing in plantations dates back to the middle of the 1950-es. *Bánó* marked out and grafted 32 plus trees, chiefly in the stands near Háromhuta.

The growth of some clones was perfect, at the age of 8 years they were higher than 4 m. The growth of other clones was very bad, at the age 8 years they were hardly 1—2 m high. Sudden death of grafts occur however since the age of 8–10 years. Unfortunately, the reason for this was not studied thoroughly, but the reason may be incompatibility.

Since Douglas fir is hard to graft, preference must be given to seedling orchards, because Douglas fir yields crops at a relatively young age.

Unfortunately, the investigation of the improvement of Douglas fir was broken off for some time. In 1968 the Forest Research Institute joined the international provenance experiment with Douglas fir organized by the IUFRO. From the observations made so far of the material coming from 104 different places the conclusion may be drawn that 10 provenances coming from the middle Eastern part of British Columbia, from the environs of Shuswap Lake, and two from the North-Eastern part of Washington State yielded the best results. This results obtained so far may naturally change depending of future hardiness to site, as well as increment and resistance characteristics.

Literature

Bánó, I. (1963): A duglaszfenyő állományok erdőművelése hazai tapasztalatok alapján. (Silviculture of Douglas fir stands on the basis of experiences in Hungary.) MTA Agrártud. Oszt. Közl. *22.* 1—2.: 93—104.

Bedő, A. (1878): A douglasfenyő, Abies Douglasii (Lindley). Erdészeti Lapok. *17.* 643—656.

(Mágócsy)—Dietz, S. (1885): A külföldi fák meghonosításának kérdéséhez. (Remarks about the question of acclimatization of exotic species.) Erdészeti Lapok, *24.* 1057—1076.

Erteld, W. (Red.) (1965): Ertragstafel, Auszüge. Neumann Verlag.

Harkai, L. (1971): A magyarországi duglaszfenyő állományok termőhelyi és fatermési vizsgálata. I. rész. A termőhelyi igény vizsgálata. (Site and yield examination of Douglas fir stands in Hungary. Part I. The examination of site requirements.) Erdészeti Kutatások, *67.* 1.: 149—168.

Járó, Z. (1963): Talajtípusok. (Soil types.) Budapest, OEF.

Járó, Z. (1968): A gyorsannövő fenyők termesztésének lehetőségei hazánkban. (Possibilities of plantation of fast growing conifers in Hungary.) Az Erdő. *17.* 49—52.

Keresztesi, B. (Ed.) (1966): A fenyők termesztése. (Cultivation of conifers.) Budapest, Akadémiai Kiadó.

Magyar, J. (1940): A fatermési táblák szerkesztésének alapkérdései. (Fundamental questions on the construction of yield tables.) Erdészeti Kísérletek, *42.* 1—2.: 1—105.

Marosi, F. (1885): A külföldi fák meghonosításának kérdéseihez. (Comment on the questions of acclimatization of exotic trees.) Erdészeti Lapok, *24.* 1171—1187.

Marosi, F. (1886): A külföldi fák meghonosításánál követendő eljárásról. (Acclimatization of exotic trees.)

Nagyné, I. (1967): Zöld duglaszfenyő-csemeték fagyérzékenységének vizsgálata. (Frost-hardiness examination of saplings of Douglas fir.) Erdészeti Kutatások, *63.* 1—3.: 174—183.

Papp, L. (1961): A duglaszfenyő jelentősége Magyarországon. (Significance of Douglas fir in Hungary.) Az Erdő. *10.* 12: 529—537.

Pausinger, J. (1877): Abies douglasii. Erdészeti Lapok, *16.* 380—381.

Solymos, R. (1968): Új fatermési táblák a magyarországi lucfenyvesekre. (New yield tables for spruce stands in Hungary.) Erdészeti Kutatások, *64.* 1—3.: 7—29.

Solymos, R. (1971): Az erdeifenyő-állományok fatermése Magyarországon. (Yield of Scotch pine stands in Hungary.) Erdészeti Kutatások, 67, 1: 203—232.

Szőnyi, L. (1963): A hazai duglaszfenyő állományok termőhelyi viszonyai. (Site conditions of Douglas fir stands in Hungary.) MTA Agrártud. Oszt. Közl. *22.* 1—2.: 79—92.

Address of the author:
L. Harkai, senior research associate
ERTI Experiment Station
9600 Sárvár

ПОЛОЖЕНИЕ И ЗАДАЧИ СОХРАНЕНИЯ ГЕНОВ В ЛЕСНОМ ХОЗЯЙСТВЕ ВЕНГРИИ

ИШТВАН БАНО—ЧАБА МАТЯШ

Из-за длительного жизненного цикла лесных деревьев вопрос сохранения генов до последнего времени не являлся столь срочной задачей в лесном хозяйстве, как в сельском хозяйстве. Преобладающая часть наших хозяйственных лесов еще и сегодня естественного происхождения по Керестеши (*Keresztesi B.,* 1973) равнинные леса до 19%, а леса холмистых и горных районов до 76%.

Однако за последние десятилетия использование селекционного посадочного материала быстро распространилось и в лесоводстве, поэтому именно интересы селекции требуют, чтобы мы занимались сохранением фонда генов наших лесонасаждений.

Целью, поставленной перед отбором, является выбор особей, обладающих благоприятными генетическими свойствами; однако, при этом может затеряться много ценных генов, так как селекционную работу нужно поставить в рациональные границы с одной стороны, а с другой стороны некоторые свойства не узнаются или их значение будет выявлено только позднее. Поэтому с точки зрения будущего селекционной работы в лесоводстве важно, чтобы по возможности сохранить естественный фонд генов лесных древеных пород (*Vidaković—Žufa,* 1965).

Метод и важность сохранения генов сильно изменяется в зависимости от древесной породы. Часть важных с экономической точки зрения древесных пород размножается вегетативным путем (евроамериканские гибриды тополя черного, ива, частично акация белая и некоторые хвойные породы), другая часть пока размножается только семенами (виды дуба, бук и важные с хозяйственной точки зрения хвойные породы).

Возможности производства посадочного материала задачу сохранения генов органичивают только древесными породами, селекция которых продвинулась и решен вопрос производства их селекционного посадочного материала. Здесь именно генетическая изменчивость древостоев в скором времени неизбежно сузится в наших хозяйственных лесах. В выращивании евроамериканских гибридов тополя черного и ивы уже давно используются сорта, размножаемые вегетативным путем. Среди хвойных пород семеноводство сосны обыкновенной в семенных плантациях может считаться разрешенным; существующие уже производственные семенные плантации (около 100 га), уже в скором будущем обеспечат необходимые количества семян (*Bánó—Mátyás—Retkes—Szőnyi* 1971).

В специальных условиях лесного хозяйства для сохранения фонда генов представляются три способа решения:

— Сохранение ценных лесных древостоев, в природном состоянии,

— Создание насаждений потомства,

— Сохранение отборных особей и популяций в специальных насаждениях.

1. СОХРАНЕНИЕ ЦЕННЫХ ЛЕСНЫХ ДРЕВОСТОЕВ В ПРИРОДНОМ СОСТОЯНИИ

Этот статический способ сохранения оказывается наиболее очевидным: заслуживающие этого древостои нужно выбрать и принять меры для их охраны. Рассматривая с генетической точки зрения, эти резерваты могут исполнять поставленную перед ними роль только в случае, если число особей в популяции довольно высокое, достигает нескольких тысяч. Извлечение необходимой для этой цели, относительно крупной площади из производства едва ли возможно исключительно из генетических соображений в отношении культурных древостоев и не может применяться. Поэтому этот метод сохранения следует согласовать с целями, поставленными перед ведением хозяйства для социально-культурных целей, где точки зрения здравоохранения, отдыха, охотничьего хозяйства и охраны биосферы могут согласоваться с требованиями сохранения фонда генов, если повреждения дичью и антропогенные воздействия не угрожают естественному возобновлению леса. По *Керестеши* (*Keresztesi*, 1973) из лесной площади страны в размере 1,5 млн. га около 450 тыс. га будет первично служить не древесной продукции. Преобладающая часть сохранимых таким образом древостоев в стране и без того находиться на территориях, потенциально служащих целям охраны биосферы и отдыха. Принимая во внимание точки зрения охраны природы и лесной типологии *Чаподи* и *Содфридт* (*Csapody-Szodfridt*, 1970) считают необходимым сохранение почти 100 лесных сообществ. Это означает выделение около полутысячи древостоев, грубым счетом на площади 2 тыс. га, что является только небольшой долей лесной площади, первично служащей не хозяйственным целям.

2. СОЗДАНИЕ НАСАЖДЕНИЙ ПОТОМСТВА

В то время как содержание резерватов генов годится в первую очередь для сохранения наших автохтонных лесных сообществ, то насаждения потомства целесообразно создать для сохранения фонда генов наших культурных лесных насаждений. В этом случае нет необходимости в извлечении выделенных древостоев из хозяйства, необходимо только позаботиться об обеспечении посадочного материала для возобновления.

У автохтонных культурных насаждений R. Toda (1965) рекомендует при выборе придерживаться следующих точек зрения:

1. древостои, показывающие очень хороший рост
2. старые насаждения
3. древостои, выделяющиеся какими-либо специальными свойствами.

Выбор и учет лучших древостоев отечественных древесных пород проведены в 1950 г. (*Mátyás V.*, 1960). В настоящее время мы обладаем т. наз. семенными насаждениями по главным породам, приведенными в табл. 1.

Для возобновления следует выделить прежде всего древостои, которые по оргхозпланам в ближайшее время подлежат эксплоатации. Особое внимание должно быть уделено тем автохтонным древостоям, которым угрожает возобновление, сопровождаемое сменой древесных пород (например, популяции дуба, тополя, приспособившиеся к экстремным условиям местопроизрастаний на маргинальных территориях), а также в связи с не автохтонными древесными породами — сохранению создавшихся местных рас («land race»).

Технические затруднения, имеющиеся в сборе семян хвойных пород, позволяют при настоящих условиях сбор семян в крайнем случае в 3—5 древостоях, следовательно едва ли можно

Таблица 1. Положение в селекции и сохранении популяций

Древесная порода	Семенные древостои		Потомства насаждений	Площадь	К-во популяций
	элиты	специального назначения		опытов с географическими сортами	
	га.	га.	га.	га.	шт.
Quercus robur	263	404	9		
Quercus petraea	297	390	5		
Quercus cerris	—	36	—		
Прочие виды Quercus	59	114	—		
Fagus silvatica	240	224	—		
Robinia pseudoacacia	15	285	—		
Прочие твердые лиственные породы	2	13	—		
Populus sp.	1	10	—		
Всего лиственных пород	877	1476	14		
Pinus silvestris	83	65	5	3,0	26
Pinus nigra	37	75	3	23,6	45
Picea abies	49	11	18	12,0	1100
Прочие хвойные породы	123	5	1	25,0	200
Всего хвойных пород	292	156	27		
Итого	1169	1632	41	63,6	1371

держать шаг с темпом эксплоатации семенных насаждений. В связи с наиболее важным родом лиственных пород, т. е. с дубом, решение сбора семян зависит прежде всего от хорошего урожая желудей и осмотрительной организации. У древесных пород, хорошо возобновляющихся с семян (дуб, бук), насаждение потомства может быть создано и на месте путем естественного возобновления (это стремление хорошо вкладывается в теперешнее наше хозяйственное направление). У древесной породы, дающей хорощую поросль (акация белая), следует хорошо обсудить и вопрос возобновления семенного насаждения с поросли.

Для возобновления семена следует собирать по крайней мере с 40—50 деревьев выделенного древостоя. Ввиду того, что выделенные деревья оплодотворяются в первую очередь пыльцой, происходящей из их окружения, при надлежащем равномерном распределении, это относительно небольшое число оказывается достаточным для представления фонда генов древостоя. Им обеспечивается довольно широкий генетический спектр для того, чтобы возобновление аналогичного характера дальнейших поколений не приводило к инцухту (*Stern,* 1959).

Поскольку возможно, то потомство следует выращивать и высаживать раздельно по деревьям, так как в этом случае одновременно получается и ценный материал для изучения структуры популяции. Разведение насаждений должно быть осуществлено производственными методами; площадь отдельных насаждений должна составлять не менее 3—5 га.

3. СОХРАНЕНИЕ ОТБОРНЫХ ОСОБЕЙ И ПОПУЛЯЦИЙ В СПЕЦИАЛЬНЫХ НАСАЖДЕНИЯХ

Выбор маточных деревьев, служащих исходным материалом для селекции, большей частью сосредоточивается на лучшие семенные насаждения. Таким образом, вегетативные или генеративные потомки маточных деревьев одновременно являются важными звеньями сохранения фонда генов. Описанные выше типы насаждений служат специальным целям, но эти цели как правило могут согласоваться с сохранением фонда генов.

Клоновые архивы и насаждения для испытания клонов создаются использованием вегетативного потомства (привитых саженцев или черенков) отборных сортов или маточных деревьев, по крайней мере шестью особями в каждом из них. Первичной целью клоновых архивов является уверенное сохранение сорта или особи; введение числа особей, представляющего одну популяцию, возможно только в исключительных случаях (например, семенное насаждение элиты сосны обыкновенной в пос. Порноапати представляется 60 маточными деревьями).

Опыты для испытания по качеству потомства закладываются в целях изучения комбинационной способности отборных особей. С точки зрения сохранения фонда генов оригинальных популяций наиболее ценными оказываются опыты для испытания по качеству потомства,

Таблица 2. Положение индивидуального отбора и сохранения

Древесная порода	К-во отборных особей	К-во особей	Площадь	Площадь испытания потомства	
		сортовых и клоновых коллекций		свободного опыления	контролированного опыления
	шт.	шт.	га.	га.	га.
Quercus robur	87	15	0,2	—	—
Quercus petraea	63	10	0,2	—	—
Прочие виды Quercus	20	—	—	—	—
Fagus silvatica	16	—	—	—	—
Robinia pseudoacacia	78	85	12,7	90,9	
Populus sp.	231	912	15,0	—	9,5
Salix sp. (деревовидные и кустарниковые вместе взятые)	51	543	24,0	—	1,9
Всего лиственных пород	546	1565	52,1	90,9	11,4
Pinus silvestris	480	420	9,0	14,2	1,4
Pinus nigra	142	176	2,0	0,5	—
Picea abies	224	200	3,5	7,5	—
Larix decidua	220	470	5,0	1,0	0,5
Pseudotsuga menziesii	25	25	0,5	0,5	—
Декоративные разновидности хвойных пород	15	230	1,0	—	—
Всего хвойных пород	1106	1521	21,0	23,7	1,9
Итого	1652	3086	73,1	114,6	13,3

заложенные с семян свободного опыления маточных деревьев, так как они могут быть практически приняты за насаждения потомства. Именно до сих пор число отборных маточных деревьев было достаточным для репрезентации генетического спектра древостоя.

В клоновом архиве, в фонде генов семян свободного или контролированного опыления наступает смещение по сравнению с фондом генов оригинальной популяции в размере, зависящем от селекционного индекса.

Целью заложения *опытов по испытанию географических сортов* является изучение изменчивости между популяциями лесных древесных пород и выбор географических сортов, лучше всего пригодных для условий данного местопроизрастания. Это является важной задачей главным образом в отношении древесных пород, размножаемых семенами, обладающих широкой территорией распространения и не автохтонных в районе выращивания; поэтому понятно, что в Венгрии опыты по испытанию географических сортов закладываются почти исключительно хвойными породами (ср. табл. 1). На долю этих опытов приходится важная роль в сохранении и демонстрировании естественной изменчивости древесных пород. Конечно, даже в отношении единственной древесной породы задачи далеко превосходят возможности одной страны, поэтому опыты такого характера организуются и координируются специальной рабочей группой IUFRO (Международная организация научно-исследовательских институтов, лесного хозяйства). Так, например, в опыте для испытания географических сортов ели, заложенном в 1968 г., принимает участие 20 учреждений 14 стран; в опыт включено 1100 популяций (в том числе 11 популяций из Венгрии) (*Szőnyi L.— Újvári F.*, 1970). Современные способы аранжировки опытов, мимо возможностей статистической оценки, принимают во внимание также и требования по сохранению фонда генов (*Giertych*, 1965).

4. ДАЛЬНЕЙШИЕ ЗАДАЧИ

Сохранение фонда генов лесных древесных пород является долгосрочной, очень многосторонней задачей. Крупные размеры и длительный жизненный цикл, частично мешающие проггрессу, в то же время могут оказаться весьма полезными с точки зрения сохранения генов. Однако, успокаивающее решение вопроса вообразимо только в рамках международного сотрудничества. Нам предстоит изучить генетическую изменчивость важных с хозяйственной точки зрения древесных пород, проводимая в отдельных странах лесохозяйственная селекционная работа должна быть координированной и следует заложить дальнейшие общие опыты. Нужно продолжать закладку лесохозяйственных банков генов и обеспечивать сохранность фонда генов угрожаемых древесных пород, экотипов. Важность задачи уже признается по всему миру (*Jasso*, 1970; *FAO*, 1973).

ВЫВОДЫ

В настоящее время более двух третей лесов Венгрии имеет естественное происхождение. Однако, все более широким применением селекционного посадочного материала требуется и в лесоводстве усиленной охраны естественных источников генов.

В результате продвижения производства посадочного материала и селекции генетическая изменчивость древостоев неизбежно суживается. В настоящее время в отношении тополя, ивы и сосны обыкновенной нужно считаться с уравновешиванием сужения. Популяциям, приспособившимся к экстремным условиям местопроизрастания маргинальных территорий, угрожают возобновления, сопровождающиеся сменой породы.

Для сохранения фонда генов угрожаемых видов и экотипов предлагаются три способа решения:

1. *Сохранение ценных лесных древостоев в природном состоянии:* годится прежде всего для сохранения автохтонных лесных сообществ (в перспективе можно рассчитывать на резерваты генов на площади около 2 тыс. га.). Для создания таких резерватов имеется возможность прежде всего на территории лесов, служащих целям охраны биосферы и отдыха.

2. *Создание насаждений потомства:* среди лучших культурных насаждений искусственному возобновлению подлежат прежде всего спелые к рубке семенные насаждения и экотипы.

3. *Сохранение отборных особей и популяций в специальных насаждениях:* из опытных объектов, созданных в ходе селекционной работы, для сохранения фонда генов пригодны клоновые архивы, опыты испытания по качеству потомства и опыты с географическими сортами.

Результаты, достигнутые до сих пор в области сохранения лесохозяйственного фонда генов, авторами приводятся в таблицах.

Литература

Bánó, I.—Mátyás, Cs.—Retkes, J.—Szőnyi L. (1971): Planning and establishment of Scotch pine seed orchards in Hungary. Part I. Erdészeti Kutatások, *67*. 2: 73—79. p.

Csapody, I.—Szodfridt, I. (1970): Természetes erdőtípusok védelme. (Охрана естественных лесотипов.) Az Erdő, *XIX*. 5: 222—226. p.

FAO ed. (1973): Forest Genetic Resources Information. For. Occ. Pap., 1973/1. Rome

Giertych, M. (1965): Adapting provenance trials towards most efficient selection and preservation of desirable forest populations. IUFRO Sec. 22. Meeting Papers, Zagreb, 13 pp.

Jasso, J. M. (1970): Impact of silviculture on forest gene resources. Unasylva, *24*. 97—98: 70—75. p.

Keresztesi, B. (1971): Forest tree improvement in Hungary. Erdészeti Kutatások, *67*. 2: 5—28. p.

Keresztesi, B. (1973): Wohlfahrtsbewirtschaftung des Waldes, Planung von Ausflugsorten und Erholungswäldern. Erdészeti Kutatások, *69*. 2.

Mátyás, V. (1960): Magtermelő állományaink célja, értelme és kezelése. (Цель, значение венгерских семенных древостоев и уход за ними.) Az Erdő, *IX*. 5: 183—191. p.

Stern, K. (1959): Der Inzuchtgrad in Nachkommenschaften von Samenplantagen. Silvae Gen., *8*. 2: 37—42. p.

Szőnyi, L.—Újvári F. (1970): International (IUFRO) Norway spruce provenance trial. Erdészeti Kutatások, *66*. 2: 47—59. p.

Toda, R. (1965): Preservation of gene pool in forest tree populations. IUFRO Sec. 22 Meeting Papers, Zagreb, 9 pp.

Vidaković, M.—Žufa, L. (1965): Preservation of the gene pool in natural stands for genetical research. IUFRO Sec. 22 Meeting Papers, Zagreb, 20 pp.

Адреса авторов:
И. Бано, старший научный сотрудник
H—9707 Szombathely,
ERTI Kámoni Arborétum
Ч. Матяш, научный сотрудник
H—9601 Sárvár,
ERTI Kísérleti Állomás

MAIN PULPING CHARACTERISTICS OF SCOTS AND AUSTRIAN PINE DAMAGED BY RHYACIONIA BUOLIANA SCHIFF.

ZSUZSA HALUPÁNÉ-GRÓSZ – LÁSZLÓ SZŐNYI – ÉVA UJVÁRI

1. INTRODUCTION

Due to the purposeful regeneration and afforestation during the last two decades in Hungary the area of coniferous stands to be thinned is increasing. The material will be used in general for pulping.

Young *Scotch Pine (Pinus silvestris L.)* and *Austrian Pine (Pinus nigra Arn.)* stands are heavily attacked by the *European pineshoot moth* (*Rhyacionia Buolina* Schiff.). Malformations are more expressed in Scotch pine pole stands on poorer sites. Malformed trees will be removed in course of the first or second intermedier cuttings. Changes in values and pulping possibilities due to malformation are outlined in the report.

Investigations as a part of a pilot research on conifer production and utilization (*Szőnyi et al.*, 1973), were initiated and coordinated by *L. Szőnyi*, sampling and chemical analyses were made by *Zs. Halupáné–Grósz*, while the anatomical analyses by *É. Újvári*.

2. SAMPLING

Both intact and damaged trees—6 for each type—were randomly sampled. Malformation types are shown in Figure 1. (Partly following *G. Maier [1971]*).

Scotch pine specimens were collected in a 13 years old, heavily attacked stand growing on periodically drained medium dry poor sand in Kiskunhalas 69/a.

Austrian pine is less attacked, so specimens were collected in two stands Kiskunhalas 93/d and 101/d, aged 7 and 10 years respectively, growing similarly on dry poor sand.

3. PREPARATION AND TESTING

Trees were full length shipped via motor freight to the field laboratory, there debarked, limbed, photoed and sampled, taking intact discs approximately at 1.30 m height from each as a basis of comparison. Standard 1 m pulp sortiment could be taken only near the thick end from each bolt. Samples were cut below, in and abowe the damaged part.

All specimens were prepared and tested according to standard procedures *(Halupáné-Grósz –Szőnyi, 1972,* and *Szőnyi et al., 1973)*.

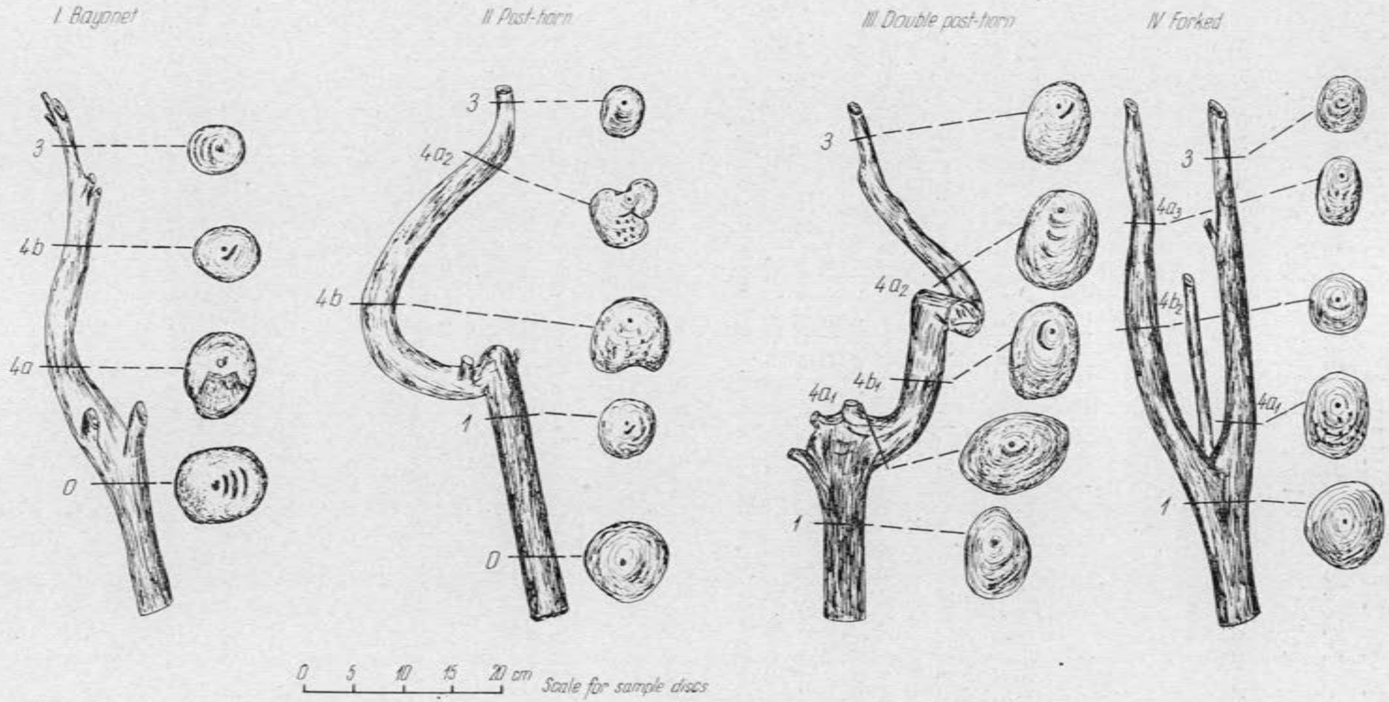


Figure 1. Scots pine malformation types due to the attack of Rhyacionia buoliana Schiff.

4. RESULTS AND DISCUSSION

4.1 Characteristics of intact and damaged logs

Extractive and lignine content (the latter related to material free from extractives) are slightly changing, depending on age and sampling spot while specific gravity decreases with height (Figure 2.).

Values of the two species at that age differ for extractives by about 1%, for lignine being nearly equal. Specific gravity of Austrian pine is higher, nevertheless decreasing with height. Same observations were made on medium aged trees, the differences for extractives and lignine, however, are more expressed; Austrian Pine having 1–2% higher extractive and 1–2% lower lignine content.

Fibre length increases with height in Scots pine and remains constant in Austrian pine, the latter having 20% longer fibres at breats height. Fibre and lumen diameter increases towards the top contrary to the wall thickness. Austrian Pine has bigger fibre and lumen diameters, thicker walls and smaller average ring width. Late wood ratio is lower in Scots pine. Specific gravity and fibre wall thickness as well as late wood ratio and fibre length values run more or less parallel for Scots pine, while this trend may be observed in Austrian pine only in the compression wood and even there on a smaller scale. Values of fibre and lumen diameter change in opposite direction as specific gravity, (in Scots pine in tensile wood only). There is only a small increase towards the top for both species. From among the anatomical properties specific gravity could be observed as most influencing fibre wall thickness and late wood ratio.

Scots pine data are similar to the results of *Nicholls* and *Dadswell* (1962) for fibre length, and to that of *Larson* (1957) for early wood ratio. Results for both species show similarity with the findings of *Panshin, De Zeeuw* and *Brown* (1964), i.e. that specific gravity values are decreasing with height.

4.2 Characteristics of damaged and differently malformed stem parts

Values of extractives in the inflections differ from those determined in intract wood; they are slightly decreasing in relation to the adjoining lower and higher stem parts, while in the fork type deformations higher values were found (Figure 3–5.). Values move opposite to lignine content.

Content of lignine in damaged parts differs from that in intact wood as well, being always higher in the inflections proportionally to the size of it, except for the fork type, where maximum values occurred in the adjoining lower straight parts. Changes in lignine content are opposite to that of extractives, but correspond to changes in specific gravity and in fibre wall thickness.

Specific gravity of damaged parts show significant increases in all types, depending on the degree of crookedness. The values are about 10% higher for the bayonet, up to 40% higher for the post-horn and 15–20% higher for the forked types. Similar change in values were observed for lignine content and fibre wall thickness for both tensile and compression wood, with the exception of the bayonet type, where this is valid in the compression wood zone only. Specific gravity and late wood ratio are similarly closely related, especially in the compression part, however, not so much in the tensile wood zone.

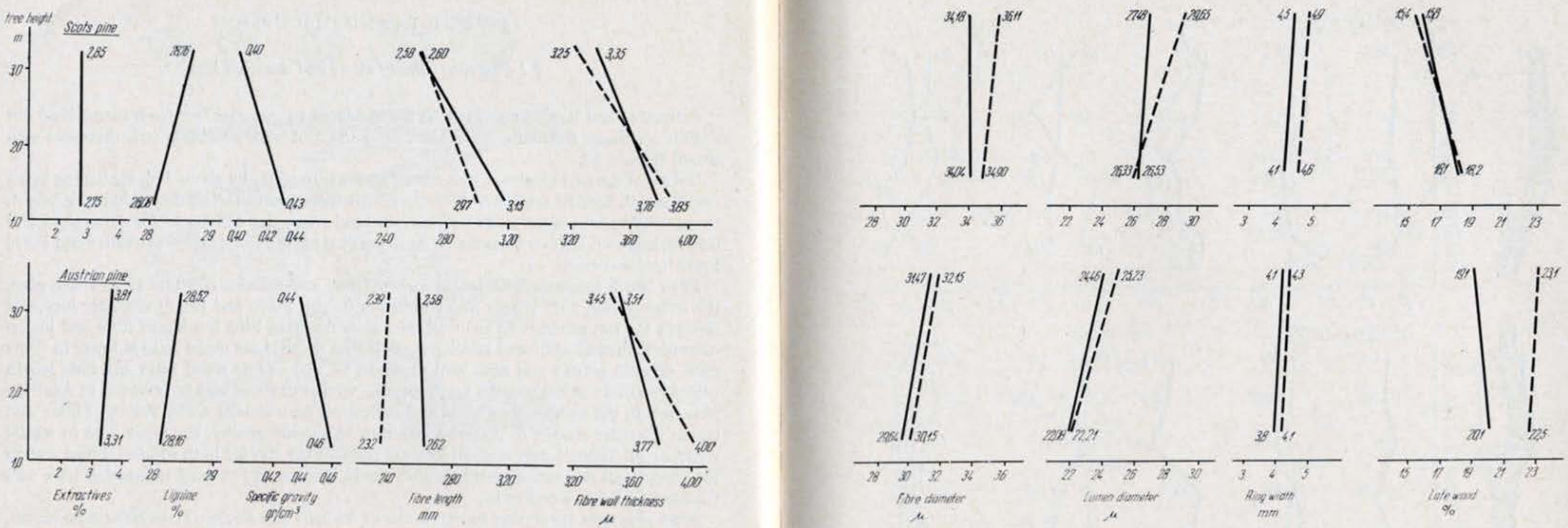


Figure 2. Variation in chemical and anatomical characteristics of sound trees

----- Tension wood ——— Compression wood

Fibre length is allways decreasing in crooks especially in tensile wood by about 20–30% in bayonet and post-horn types. The differences in the compression zone are significant at P=1% level.

Fibre wall thickness shows the closest relationship with specific gravity from among anatomical traits. Highest values were measured in crooked parts; in extreme crooks up to 30% higher, giving a motive for high specific gravity values. Values in intact wood increase uniformly, however not significantly, towards the top. Differences were significant at P=5% level.

Diameter of fibre and lumen display similar tendencies. In damaged parts data show abnormalities and usually change in the opposite direction as wall thickness.

Ring width is slightly increasing with height in sound wood, but not so in the malformations. Excentricity of sample disks from crooked parts results from the different number of fibres on the compression and on the tension side, while fibre shape remains unchanged.

Late wood ratio values in sound wood decrease in Scots pine significantly towards the top, while in Austrian pine this is true for the compression side and even there it is less expressed. In damaged parts values increase, especially in forks (Figure 6.). Specific gravity is strongly influenced by late wood ratio, as well as by wall thickness.

5. GENERAL COMMENTS

Chemical, physical and anatomical indices in malformations change considerably and disadvantageously for pulping. As a result, mostly on account of high wall thickness and lignine content values, *sound and malformed tree parts should not be mixed in the pulp;* the latter should be discarded.

6. UTILIZATION OF DAMAGED TREES

Malformations occured 10 cm above breast height the lowest, mostly considerably higher. In the given age group standard pulpwood could be cut below breast height, thus these logs were even in the most unadvantageous cases more than 20 cm apart from the malformations, the average distance for Scots pine being 1.07 m (0.20–2.0 m) and for Austrian pine 1.73 m (0.3–4.20 m). Extractive and lignine content slightly differed in parts nearer than 50 cm to malformations, but the differences of 1–2% were not significant.

In general *pulpwood taken from young damaged Scots and Austrian pine stands near the ground may be pulped as sound wood assortments.* Due to technical development even weaker

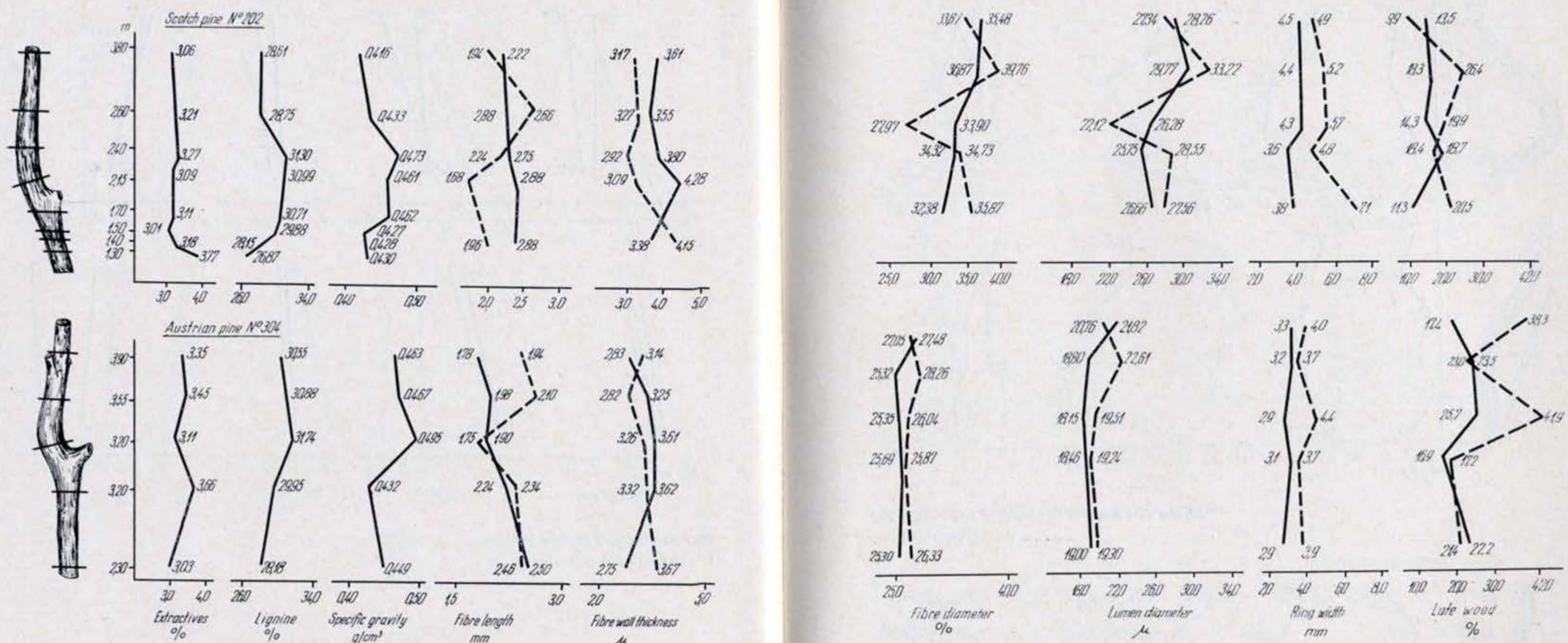


Figure 3. Varation in chemical and anatomical characteristics of malformation type I. (bayonet)

- - - - - Tension wood ——— Compression wood

wood may be pulped as well, but malformed parts are to be excluded, at least 10 cm below and above the crooks. Because of the unfavourable high lignine content in case of forks the excluded section should be longer below the forking.

SUMMARY

1. In sound Scots and Austrian pine extractive and lignine content slightly increase with height, while specific gravity decreases. Fibres were by 20% longer at breast height in Scots pine as in Austrian pine, the length decreasing with height, however to a less extent in the case of the latter. In Austrian pine fibre and lumen diameter is smaller, fibre walls thicker,

and the late wood ratio (and, accordingly, specific gravity) higher. It was observed, that the specific gravity is mostly influenced by the wall thickness and late wood ratio.

2. Young trees damaged by ***Rhyacionia buoliana*** Schiff. show different types of malformations (Figure 1.). Anatomical and chemical characteristics of damaged trunks and the tendency of their changes are different related to sound wood (Figures 2–6.). Lignine content is higher, walls thicker, fibres shorten, late wood ratio smaller and specific gravity is significantly higher. All these traits are disadvantageous for pulping, thus malformed tree parts must be sorted out. The intact parts of attacked trees are only slightly different related to sound trees, thus pulpwood taken from these sections may be processed together with sound timber.

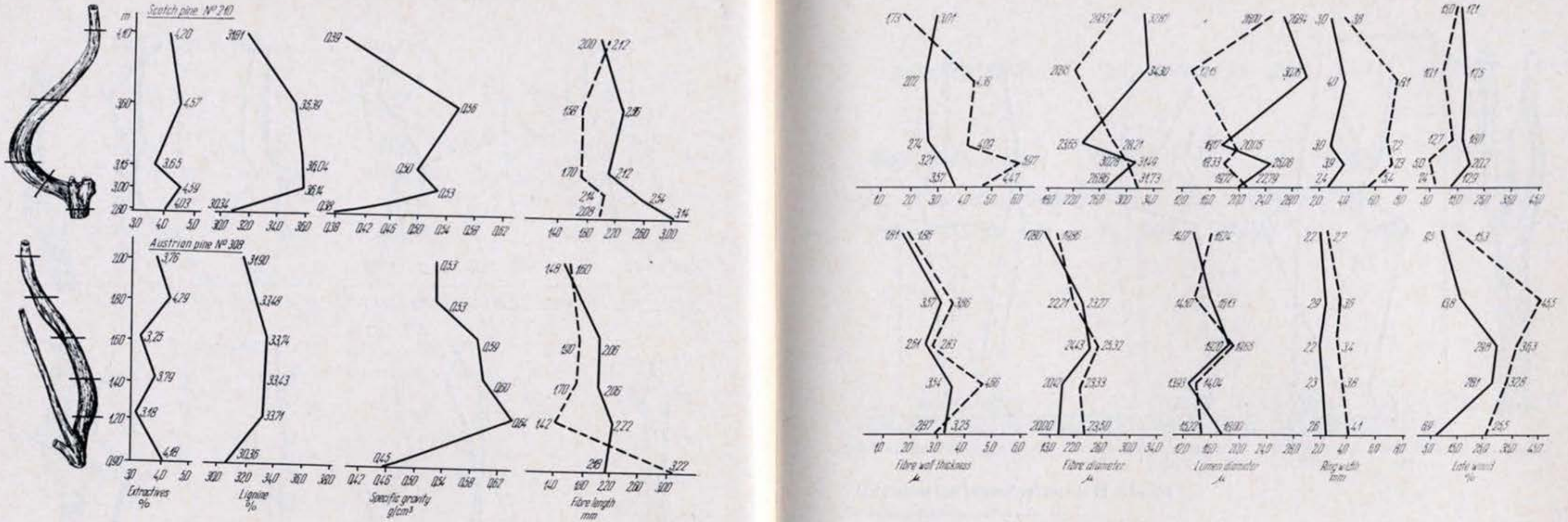


Figure 4. Variation in chemical and anatomical characteristics of malformation type II. (post-horn)

----- Tension wood ——— Compression wood

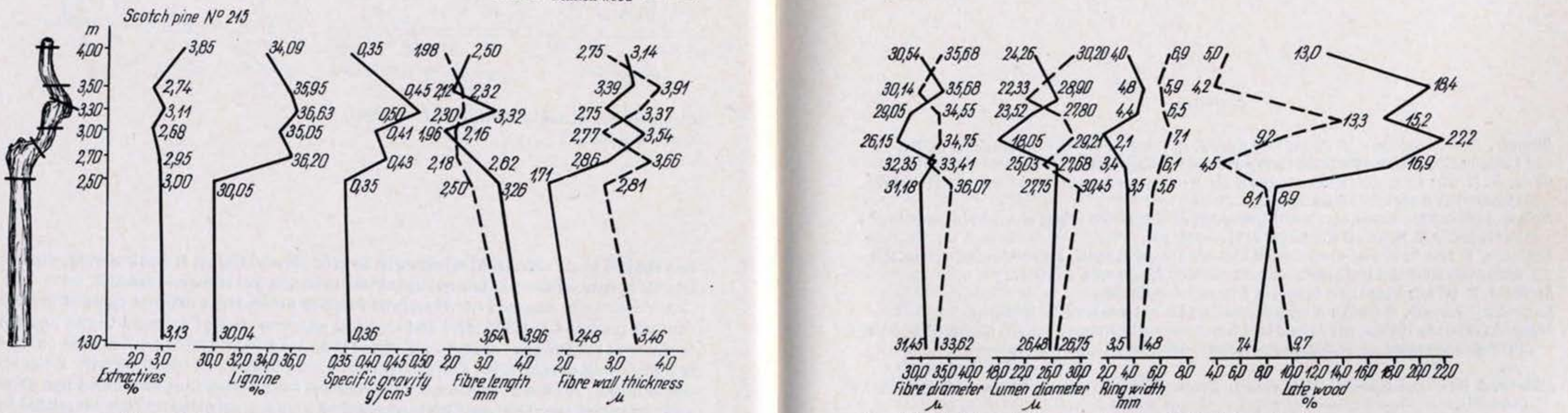


Figure 5. Variation in chemical and anatomical characteristics of malformation type III. (double post-horn; rare type, crooked in 3 dimensions)

----- Tension wood ——— Compression wood

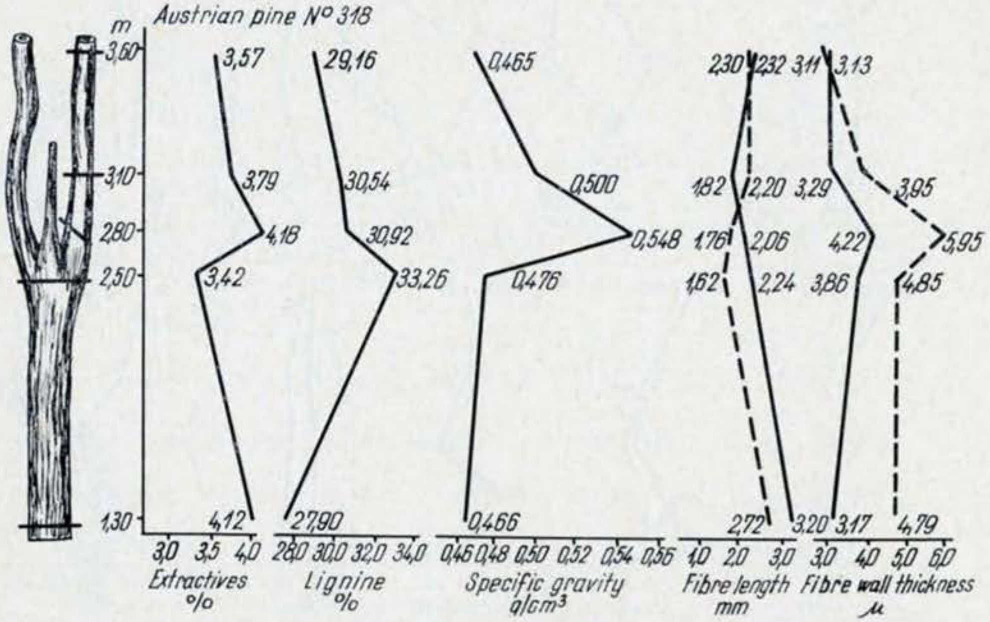
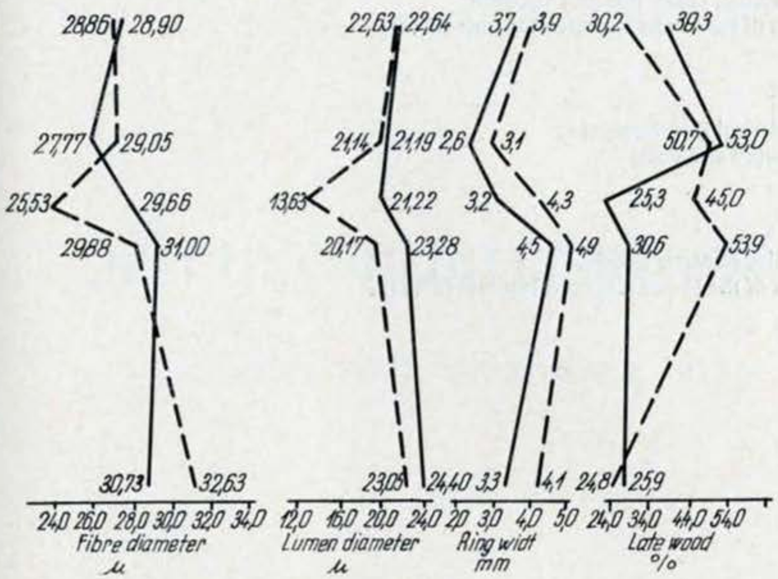


Figure 6. Variation in chemical and anatomical

----- Tension wood ———



characteristics of malformation type IV. (forked)

Compression wood

Literature

Einspahr, D. W.—Buijtenen, J. P. and Peckham, J. R. (1969): Pulping Characteristies of Ten-Year Loblolly Pine Selected for Extreme Wood Specific Gravity. Silvae Genetica 18, 57—61 pp.

Götze, H. (1966): Über die Gesetzmässigkeit der Raumdichteverteilung bei Kiefer-Jungbeständen. Eberswalde. Rohdichte Holzwerkstoffen.

Halupáné-Grósz Zs.—Szőnyi, L. (1972): Utilization of Scots Pine (Pinus silvestris) in the Pulp and Paper Industry. Erdészeti Kutatások *2.* 119—128. pp.

Hoffmann, K. (1966): Betrachtungen zur Rohdichte aus der Sicht der Forstpflanzenzüchtung. Rohdichte von Holz und Holzwerkstoffen. Eberswalde Symposium. 103—113. pp.

Larson, P. R. (1957): Yale Univ. School of Forestry Bulletin, No. *63*.

Lengyel, P.—Morvay, S. (1965): A cellulózgyártás. Műszaki Könyvkiadó, Budapest.

Maier G. (1971): Ermittlung des Anteils schwerer Stammverkrümmungen durch Kieferntriebwickler in Kiefernbeständen der badischen Rheinebene. Allgemeine Forst- und Jagdzeitung. *7.* 188—195. pp.

Nicholls, J. W. P. and Dadswell, H. E. (1962): Forest Products Technical Paper *24*, C.S.I.R.O, Australia.

Panshin, A. J.—De Zeeuw, C. — Brown. H. P. (1964): Textbook of Wood Technology, Volume 1; 2nd Edition (Mc Graw-Hill, New York)

Poller, S. (1966): Über die Bedeutung der Rohdichte des Holzes in der Zellstoffindustrie. Eberswalde 201—216. pp.

Poller, S.—Zenker, R. (1968): Vergleichende anatomische, chemische und zellstofftechnologische Untersuchungen an dickem und dünnem Kiefernholz. Zellstoff und Papier 1968. I. 20—25 pp.

Posey, C. E. and Robinson D. W. (1969): Extractives of Shortleaf Pine: An Analysis of Contributing Factors and Relationships. Tappi. Vol 52. No. *1.* 110—115.

Schalck, J. (1967): Über die Rohdichte und Festigkeit des Schwarzkiefernholzes (Pinus nigra Arnold) und den Zusammenhang zwischen Rohdichte und Holzstruktur, untersucht an belgischen Aufforstungsbeständen. Forstwissenschaftliches Zentralblatt, Beiheft. Heft 24.

Sugden. E. A. (1967): Wood Characteristics and Wood-Pulp Quality. Columbia Cellulose Company Limited. Research and Development Division. New Westminster, V. C. Pulp and Paper Mag. of Canada, 68. *6.* 273—279. pp.

Szőnyi L.—Babos, K.—Hajduczkyné I.—Halupáné, Zs.—Lengyel, P.—Újvári, É. (1973): Pulp and paper production from the main conifer species in Hungary. Erdészeti Kutatások 2. (in press)

Zenker, R. (1966): Die Rohdichte, Bindeglied zwischen Struktur, Rohdichte von Holz und Eigenschaften des Holzes. Eberswalde Rohdichte von Holz und Holzwerkstoffen. 13—29. pp.

Address of the authors:
Dr. Zs. Halupáné-Grósz, senior research associate
Experiment Station of the Forest Research Institute (ERTI)
9600 Sárvár

Prof. Dr. L. Szőnyi
Department of Technical Development
Ministry of Agriculture and Food
1055 Budapest
Kossuth tér 11.

Mrs. É. Újvári, senior research associate
Experiment Station of the Forest Research Institute (ERTI)
3232 Mátrafüred

MEETING OF IUFRO DIVISION I.

BUDAPEST, SEPTEMBER 1973

REPORT ON THE SESSION OF IUFRO DIVISION I. IN HUNGARY

REZSŐ SOLYMOS

The good connection between the International Union of Forest Research Organizations (IUFRO) and the Hungarian forest research dates back several decades of years. It was in Hungary that the IUFRO held its Congress in 1936. The Professor *Gyula Róth* was elected chairman of the IUFRO. This meant that the Hungarian forest research was also of world-wide reputation.

After second World War the organization and activity of the IUFRO have changed and been modernized together with the rapid development of forestry and forest research. Especially the IUFRO Congress of 1971 in Florida brought significant changes in organization and working methodology. The respective departments, working and planning parties were reorganized with regard to multiple use forestry. At the same time the "European" character of the IUFRO has weakened and its scope of activities has extended all over the world.

The "overseas" forest researchers gained the mastery over the Union, so that they could and can realize their ideas decidedly within it.

Between the congresses—being the supreme forum—the individual departments hold their meetings every two years, devoted usually to some important subject of current interest. In the course of these meetings the working parties discuss the results of the various researches, which are thought necessary to be coordinated internationally. A field-trip (study-tour) connected with the respective subject is also arranged during the meeting, in the course of which the organizing country displays the results of researches obtained, affording an opportunity to discuss the problems on the spot.

The Division of Silviculture and Environment Protection and its nine working parties had their meetings and study-tours according to schedule in Hungary from 9–16 September, 1973. The main topic, suggested by the coordinator of the Division, *Prof. Dusan Mlinsek*, was: "Silvicultural research, education and practice". The timeliness of the topic, in my opinion, is indisputable in our days, when

— the traditional silvicultural research is replaced by new forms of research, in both objectives and methods,
— the harmonious combination of theory and practice must be effective in education,
— the practice must be adapted to the quick changes in social and economical demands.

The preparations for the session in Hungary started in 1973. As for the IUFRO, Prof. Dusan Mlinsek (Yougoslavia), Prof. Hannes Mayer (Austria) and Prof. van Migroet (Belgium) took part in it. The chairman of the Hungarian organizational committee was: Dr. Béla Keresztesi, secretary: Dr. Rezső Solymos, members: Dr. Elemér Csesznák, Gyula Fekete, Dr. György Lengyel, Dr. Antal Majer, Dr. János Páris.

The whole program included full sessions, meetings of the working parties, two study-tours directed towards two different regions, as well as the closing session, evaluating the results. The sessions and meetings took place in Budapest, on one of the study-tours the participants surveyed the typical examples of silviculture in the space between the Danube and the Tisza, on the other those of Transdanubia.

The main topic of the full session was: *"Silvicultural research, education and practice"*. After the opening speech delivered by Prof. *Dusan Mlinsek,* The coordinator of the I. Division, the first lecture was held by Deputy Minister *Dr. András Madas* on "Silviculture and environment protection in Hungary". He stressed that the perception of the triple function of forest and its realization in the future silviculture set new tasks to the silviculturists. The optimal usefulness of forests for the public welfare will be secured by the well-established combinations of the main functions, adapted to country-wide and regional, medium and long-range demands in the interest of both the economic life and the forest sector. The first lecture was followed by that of *Dr. Béla Keresztesi* Director-general of the Forest Research Institute (ERTI), on "Research in forestry and environment protection". He emphasized thet the conception of the development of forestry and forest research in Hungary awoke world-wide interest between the two world-wars. In 1936 the IX. Congress of the IUFRO and the II. World Congress of Forestry Economics were held in our country. The current forest research is characterized by the elaboration of complex production technologies. We have a scheduled plan for up-to-date researches into environment protection, coordinated by the Forestry Research Institute. *Dr. Antal Majer,* Professor and head

Figure 1. Audience of the plenary session in Budapest

of department, delivered a lecture on "Silvicultural instruction and research at the University of Forestry and Timber Industry". Instruction of silviculture has always been important part of the higher education of forestry, started in Hungary in 1808. The fundamentals of silviculture in our days comprise the subjects forest typology and stand structure. 65 percents of the instruction are practice. The birthplace of forest research in Hungary was just the Department of Silviculture. The development of silvicultural research severs to improve the instruction, too. *Dr. Rezső Solymos* department head at the Forest Research Institute (ERTI) reported about "Silvicultural research in the Forest Research Institute". From among the research themes pursuited in the Forest Research Institute concerning silviculture the results in site survey, forest improvement, production of propagation material, afforestation, forest tending and yield science, as well as forest protection were emphasized. The results are being put into practice at present. Further aims of research are: simplification of silviculture, reduction of labour demands, increasing economic efficiency, simultaneous increase in quantity and quality of timber production in view of the three functions of forest.

After these Hungarian lectures, Prof. F. Fischer (Switzerland), Prof. H. Thomasius (G.D.R.), Prof. van Migroet (Belgium) and J. Rowe (United Kingdom) held their lectures. Prof. *Dr. F. Fischer* stated in his lecture on "Effective methodology of silvicultural instruction" that the silvicultural instruction must be in line with the forestry economical policy of the respective country. The best lecture-room is the forest itself, the practice plays a particularly important part in training. He deemed it advisable to draw up new suggestions utilizing the sound experiences from all over the world for developing the silvicultural instruction and discuss them in the next session. In his lecture on "Experiences in silvicultural instruction after the educational reform in the G.D.R." Prof. Dr. *H. Thomasius* urged that besides the professional instruction the personality of the students should also be developed and the lecturer should make use of pedagogic techniques. The students should be enabled to enrich their knowledge of silviculture and put them into practice by themselves. According to the instructional plan the sense of vocation should be raised. The ability to solve both complex theoretical and practical questions should be developed. The postgraduate studies of silviculturists should also be organized.

The fundamentals and objectives of silvicultural researches were summarized in the lecture of Prof. Dr. *M. van Migroet*. He stated that in the forthcoming period the positive knowledge should be expanded, the methodology of silviculture should be critically analysed, as well as the problems to be expected should be solved. The growth rhytm of the trees, the metabolic processes, the flowering and the formation of fruit and seed, the growth processes, nutrition and but formation should be examined. The norms of absorption of water and intake of energy in the various species of trees, the dynamics of the growth of forest stands, the changes in yield of wood and the water and energy balance of the site should be investigated. Among the tasks set for the future the examination of the response of various tree species to environmental changes of large areas, the elaboration of the new technology of nurseries, as well as the clinical control of growth and development were mentioned. The last lecture was held by *J. Rowe* (United Kingdom) on "Problems of interrelation between forest and game" (published in full length in this volume).

On the day following the full session, on September 11th, the single working parties held their meetings in the rooms of the central building of the Forestry Research Institute. The major results of the discussions of special questions and working plans are summarized as follows:

S. 1.01–1. Working Party: "Primeval forests"

— The remains of primeval forests and natural forest reserves should be surveyed and registered as soon as possible.

— An urgent task is to compile the documentation of literature referring to primeval forest published so far.

— The experiments made so far should be critically supervised and uniform research methodology should be drawn up, so that the results might be compared more easily.

— An appeal to every country all over the worlds should be prepared, calling upon them to establish natural forest reserves, especially in the tropics and subtropics.

— The Working Party dealing with "Primeval forests" should schedule a touring of the Caucasian primeval forest reserve on the occasion of its next meeting in Turkey in 1975.

S. 1.01–2. Working Party: "Silviculture in mountainous regions"

The main topic was: "The upper limit of forest growth as a silvicultural problem".

— Work planned for the examination of the criteria of the natural and the actual forest limit: selection of examination objects, marking out their limits, elaboration of their criteria, necessary for the analysis of the forest structure and dynamics.

— Determination of the optimum growth and increment value of the site of forests in mountainous regions.

— Improvement of information on current works, compilation of bibliography containing summaries in German and English

S. 1.05–3. Working Party: "Tending of young stands"

— In the future the Working Party will publish the proceedings in French, German and English.

— The comparative examination of methodology of tending of young stands in various countries should be continued as one of the tasks.

— In 1975 a meeting is to be organized for the discussion of this topic.

— The definition of "stand cell" should be regarded as a fundamental question.

— Passing-on of working experience and information is imperative in general; effort must be made to speed up the flowing of ideas.

— There seems to be no need for continuing fertilization experiments.

— The function of the forests may change with the age of the stand; this must be taken into consideration in the course of tending young stands.

S. 1.05–5 Working Party: "Thinning experiments in Europe"

— Out of 24 planned spruce experimental areas 20 experiments were executed by the Working Party, established in 1969.

— Adequate methodology could be formed for each of the countries participating in the experiments.

— The computer program developed requires some completion, to be dine as soon as possible.

— The working hypothesis underlying the experiments should be elaborated by means of growth models.

— The parties concerned should be informed on the experiments through a comprehensive booklet.

— The next meeting of the Working Party is to be held in Ireland from September 2–7, 1974.

S. 1.05–6 Working Party: "Multiple-use silviculture"

— Double objective for the next period:

— drawing up a program of work,

— organizing the Working Party, for the realization of the program agreed upon.

— The initial experimental aim is to bring about forest stands that include both the theory and practice of the multiple objectives of silviculture.

— The Working Party agreed on the working plan for the period until the next Congress in 1976 as follows:

— Consequences of the multiple use of forests on silvicultural researches.

— Research of the influence of "normal" silvicultural procedures on the utilization of important forest types all over the world.

— Specific studies concerning the multiple use and its effect on silvicultural practice.

S. 1.05–8. Working Party: "Natural regeneration of stands"

— The main task is to establish a uniform methodology of research of natural regeneration and compile a bibliography referring hereto. In this sense the members were asked to present suggestions.

— The factors of natural regeneration that may come into question, when experiments in natural regeneration are compared, should be listed.

— The next meeting of the Working Party is planned to take place in Roumania in 1974, with the main topic: methodology of research of natural regeneration.

— The problem of regeneration of tropical forests will be committed to a special Working Party.

S. 1.08. Working Party: "Management of wildlife habitats"

— Two topics were discussed:

— 1.08–1. Influence of silvicultural procedures on game habitats.

1.08–2. Classification of game habitats.

After the meetings of the Working Parties, on September 12, 13 and 14 the participants attended the program of the study-tours. Our visitors from abroad, guided by *Dr. Béla Keresztesi* and *Dr. István Szodfridt,* got acquainted with the growing of Robinia, poplar, conifers and oak in the area between the Danube and the Tisza. During the tour the management of the forests of Pusztavacs, Gemenc and Bugac, the results of the forest and wildlife management at Gemenc, as well as the methods of planting and thinning of conifers and of production of propagation material raised considerable interest, while the forest preserve

Figure 2. Participants of the Great Plain study tour

at Bugac with ethnographical and scenic glimpses of the "puszta" were welcome non-professional experiences.

The participants of the second study-tour, guided by *Dr. Antal Majer* and *Dr. Rezső Solymos,* were given an overall picture of planting poplar and conifers, of regeneration of hornbeam, oak and beech in the Transdanubian forests. At Devecser the thinning experiments in the poplar plantation of the State Farm was visited. The Scotch pine cultivation experiments at Csipkerek showed many results of the complex research project on conifers. Production of improved propagation material, spacing experiments, thinning, yield science, forest and timber protection were the main research themes touched. At Sárvár the Experiments Station of the Forest Research Institute (ERTI), and the nearby hornbeam—oak mixed forests of Káld—Farkaserdő were visited. It was an interesting experience to see the beech experimental plots at Farkasgyepü, which first had been shown in 1936 to the participants of the IUFRO Congress by Professor *Róth*. His work was complemented and expanded by his successors. The imposing series of experiments gave a comprehensive picture of the silviculture going on in the natural forests of our country. The waste-land afforestations of Veszprém and the work of the Balatonfüred Afforestation Department of the ÁEMI were displayed as well. The Balatonfüred Afforestation Department is doing internationally recognized work in planning afforestations of public interest and green belts.

After returning from the study-tour, the closing session took place in Budapest. In the course of this *Prof. Dr. D. Mlinsek* expressed the participants' satisfaction with the silviculture in Hungary, which is supposed to be able to carry out the major tasks coming from

Figure 3. Visit in a Transdanubian poplar spacing experiment

the triple function of forests. With the closing words of *Dr. Béla Keresztesi* the session came to an end, followed by a sociable reception given by Deputy Minister *Dr. András Madas*. It may be stated that it was generally felt that the session was a success, hit the target, worked worthily in the all-important cause of the progress of silvicultural research, education and practice.

The next session of the IUFRO Division I is to be held in Turkey in 1975.

SILVICULTURE AND ENVIRONMENT-PROTECTION IN HUNGARY

ANDRÁS MADAS

The first phase of the international campaign aiming at the protection of human environment is approaching its end. This is characterized by the fact that the feature and importance of the problem has become obvious for the human race. The World Conference in Stockholm summarized the recognition and pointed out that now the period of concrete action should follow. Going beyond this recognition the socialist states have expressed their intention that following the common resolutions of the Council for Mutual Economic Aid and also in the procedures taken by the individual countries they are working out determined measures.

The environment, determining the physical existence of men, their intellectual and social development, is a uniform system. The natural and artificial constituting elements of our environment are in close correlation with one another, there is an interaction between them. Therefore the harms done to the individual constituting elements of the environment effect it as a whole.

The human environment, as a concept, involves the following factors:

1. The natural environment of society;

   — soil
   — air
   — water
   — flora
   — fauna.

2. Artificial environment.

Environment protection means the correlated system of the following measures:

— protection preventing damages,
— the suppression of the damages caused,
— development of the human environment,
— the rational utilization of the natural resources.

The environment protection has the task to keep the environment in a suitable condition for human existence, which can be assured only by the complex coordination of all the biological and technical activities and with taking into consideration the demands and the economic and social possibilities. The realization of the world-wide and national social requirements connected with environment protection is only possible throughout a longer period and by means of very considerable financial sacrifice.

Within this question which has become so important for the human race forests have got a large and increasingly growing significance. Nowadays forests are forming the only part of our living space on which the natural conditions can survive more or less undisturbed.

The 7[th] World Forestry Congress held in Buenos Aires in 1972 pointed out unanimously the world-wide role and significance forests are playing in the protection of environment. The slogan of the Congress:

"The forests and economic-social development" hailed the widening and growing role of forests.

The fundamental functions of forests in providing many kinds of facilities and service for mankind were determined by the 7[th] World Forestry Congress as follows:

a) production
b) environment protection
c) social functions and recreation.

The function of production is realized through the activity of private and state enterprises and has to fulfil the condition that the yields should correspond to the same level of costs or should surpass them.

Environment protection, social and recreation services of forests may be attained partly without planning, even accidentally, because they are relevant in the character of the forest itself. These services however may be assured properly by common efforts only, in general through government activity and in some way to the account of the budget.

Environment protection and the social-recreation functions—compared with the production function—are getting an increasing importance in almost all countries even if their stage of development is different, but in any case the production function continues to keep the lead. Only the well-founded combinations of the principal functions, adapted to the needs of the country or continent, middle-term and perspective requirements, can provide for an optimum utility of forests, for public welfare and in the interest of the whole economic life and of the forestry sector.

This fact makes it decisively important that foresters should be in possession of clear concepts about the internal correlations of the forest functions, about their influence displayed on economic life, about the methods of the financial and budget-covering activity and besides they should assure that the planners and the decisionmakers should—at all levels—be well acquainted with these characteristics and with the possibilities of the sector concerned in the promoting of the social and economic development.

The factors of environment protective role of the forest are the following:

— Nature- and landscape protection, maintenance of the wild-living flora and fauna
— control of water-erosion, collaboration in the different tasks of water-management (protection against floods, production of drinkwater etc),
— control of wind-erosion,
— protection against air-pollution,
— protection against the different harms caused by noise.

The recognition of the triple function of forests and its realization in the future forest management sets the silviculturists new tasks. Until the sixties the task consisted essentially of the solving of a fundamentally single aim, that is the tending and regeneration of forests, planting new forests, increasing the productivity of forests, satisfying the requirements of timber in the people's economy.

The appearance of environment protection and that of social and recreation tasks however means a more complicated task for the silviculturist. Let us mention the problems one by one:

Ninety per cent of the Hungarian forests are broad-leaved stands. Learning from experiences in Europe of the past decades, the pine and poplar plantations have been planted on very carefully chosen sites. These plantations served however exclusively the aim of increasing wood exploitation. In order to assure environment protection, social and recreation functions of forests, greater care must be taken, however, of the maintenance of the natural forest-types or of their reestablishment, respectively, and a still more increased attention must be paid to afforestation areas where under all circumstances such tree-species should be planted which are suitable for the site and are resistant with full certainty to the biotical as well as to the abiotical injuries.

In afforestation a more increased role should be granted also to aesthetical aspects of forests, when choosing tree species for planting.

In the regeneration of forests we wish to assure a more intensive role for natural regeneration and for the creation of the necessary preliminary conditions. In the course of forest tending we are—in the operative plans—describing compulsorily the carrying out of cleanings, as well as the selective and yield-increasing thinnings, in due time and in adequate form.

While our enterprises are endeavouring to assure their economic results i.e. to work economically first of all in the tending of forests, we are, however, working for the future and are providing also the financial conditions as far as it is necessary. Therefore, we are prescribing, demanding and realizing forest regeneration and forest tending in the interest of all three functions of the forest, to a more increased extent. Whereas our intention is to follow substantially the objectives pursued up to now in exploitation, regeneration and tending, by emphasizing the growing and widening tasks of forests, regarding the plantation of new forests we wish to follow a policy diverging from the former one to a certain degree.

During the past 25 years, we planted 400,000 ha new forests and during this time the forest area of Hungary rose from 12.6 per cent to above 16 per cent. The plantation of new forests served first of all the more extensive needs in timber for the country, but at the same time it has utilized such areas which could not be cultivated economically in agriculture. In the period standing before us we wish to increase to annual pace of forest plantations on the one hand and to modify its unilateral objectives on the other hand.

As can be foreseen, we shall plant round 70,000 ha new forests in our fourth Five-Year Plan during the years from 1971–1975. In our following Five-Year Plans we intend to realize a pace greater than this.

In this and in the preceding Five-Year Plans—as mentioned already—the forest plantations are intended first of all to serve the fulfilment of production tasks. In order to assure the environment protection functions of forests we have to follow—in the future Five-Year Plans—a special systematic order in forest plantation and afforestation, for the sake of assuring the environment:

- — green belt plantations serving the reduction of the harms of urbanization, the improvement of the environmental establishments, first of all in the area of the capital and of the larger towns,
- — forest plantations of the catchment areas in regions of water sources,
- — forest plantations of the complex soil-protection plans,
- — protecting afforestations of linear establishment,
- — other forests and afforestations for nature conservation, landscape-protection and protection of construction works,
- — forest plantations serving exclusively wood production.

The Hungarian foresters are preparing themselves to solve the growing tasks and for the sake of the whole society, they undertake the realization of the new, modern silvicultural tasks with great enthusiasm.

Address of the author:
Dr. A. Madas, deputy minister
Ministry of Agriculture and Food
1055 Budapest
Kossuth Lajos tér 11.

FOREST AND ENVIRONMENT RESEARCH IN HUNGARY

BÉLA KERESZTESI

In consequence of the territorial regulations of the Peace Treaty for Hungary a special forestry situation arose in 1920. Following the annexation of the mountaneous regions to the neighbouring countries, timber exporting former Hungary became a timber importing country. The demands for soft-wood had to be satisfied entirely by import. Aiming at the urgent solution of the situation of wood supply, which had unfavourably influenced the whole economy of the country, a comprehensive concept was elaborated for the development of forestry. To provide the scientific basis for development, the Hungarian forest research had been reorganized. The concept for developing forestry and forest research brought the international interest of experts, too, so that the Ninth IUFRO Congress and the Second World Forestry Congress were held in Hungary in 1936.

After the Second World War two third of the forests were nationalized, large state forestry enterprises were organized, and the planned socialist economy was introduced. Conformable to this the former concept of forestry development was completed, improved and an overall development program for wood, pulp and paper industry was worked out. For this purpose forest research had considerably been developed and research institutes for the wood and paper industry were organized respectively. The research having been in accordance with the interests of the production was incorporated in a coherent system of a ten-year (1961–1970) national long-range plan coordinating the forest research and the wood and paper research with the agricultural and industrial research. Concerning the practical realization of research results in forestry working with long production periods a system was worked out in which the practical production activity of the coming five-year planning period was regulated on the base of research results achieved during the period of the former five-year plan. The research results worked out as complex production methods, technologies are being prescribed by the Ministry of Food and Agriculture (MÉM) as directives to the forestry enterprises.

Since the economic reform introduced in 1968 the role of long-range plans and prognosis (beside the one-year and the five-year plans) has been increased in the planned economy. The profil and the new basic objectives of forestry, wood and paper industrial research institutions were determined according to the 15-year long-range plan (1970–1985) of forestry and wood processing industry. For the realization of the basic objectives complex research plans were worked out for 5–10 years in cooperation with the research institutions. Previously research themes had dealt only with one section of the production problems. The new complex target research programs and work plans aim at the working out of complex production technologies. This kind of work requires the coordinated activity of larger research teams. Further development is characterized by the fact that the Ministry changed the former system of financing the research institutions into the system of directly financing the target programs and work plans in the form of credits for research and investment allowances for 5–10 years. This financial provision makes a sound and undisturbed research activity possible.

At the *Forest Research Institute* (ERTI) the elaboration of a target program entitled "Complex research on growing, utilizing and substituting conifers and their wood material" and of the following projects are going on:

— Elaborating directives for growing broadleaved trees,

— Elaborating the conceptual measures of forest protection and methods for controling forest deseases,

— Investigating the economic conditions and incentives of wood production,

— Complex development of wildlife management,

— Complex technical development of felling and transportation.

It appears from the above list, that there are no departments of silviculture or mensuration. These types of forest research are carried out within the framework of the target program and work plans mentioned above. Research foresters, however, working on the field of silviculture or mensuration take part in methodical discussions and evaluate the research results 2–4 times a year.

The *University of Forestry and Forest Industry* is working on the following projects of extented range:

— Complex research on utilizing non-timber forest products.

— Up-to-date application of wood in building living and weekend houses.

The *Research Institute of Wood Industry* has the following work plans of extended range:

— Protection of wood material,

— Economic analysis for improving the balance of wood consumption,

— Developing up-to-date mechanical and chemical processing of native hard woods,

— Optimal utilization of the industrial wood material of oaks, beech, and locust-tree.

The *Institute of Research and Development for Paper Industry* has the following research tasks connected with forestry:

— New methods of processing hard woods for cellulose production,

— Production of craft papers by utilizing short fibre cellulose,

— Production of new compound-paper materials,

The Sopron University, the Research Institute of Wood Industry and the Institute of Research and Development for Paper Industry take part in elaborating the complex research projects and the target program directed by the Forest Research Institute, which is also coordinating the research projects of the institutions mentioned above.

According to the data from about 1967 Hungary (as well as the other socialist countries) has a considerable research basis and research allowances in relation to its economic development. The number of scientists and engineers related to 10,000 inhabitants is 14.8 in Hungary, which is better than a medium place when making an international comparison. Regarding the education or specialization of scientists and engineers working in research, the joint share of agricultural and technical sciences serving the production of material goods directly is 60 per cent in Hungary.

In 1966 the role of the *wood economy block* (*forestry* dealing with wood production, transportation and all the benefits and influences of forests, the *primary wood industry* including saw-mills, board, pulp and paper industry, the *secondary wood industry* including furniture production, lumber and joinery industry, cask, packing and other mixed wood industry) was characterized by the following data: share in the Gross National Product 3.1%, in the National Income 3.2%, from the additional value (GDP) 3.0% and in the total number of employees 3.0%. The research institutions of the wood economy block had a share of 1.6% regarding the research institutions of the country and represented 1.2 per cent ot the total posts. Allowances given to the research institutions mentioned above represen 1.0% of the entire allowance.

*

The protection and improvement of our natural environment belong to the most important and most difficult tasks to-day. When solving the essential executive, organizational, planning and managerial tasks of environmental protection the scientific environmental research is indispensable. The Ministry of Food and Agriculture had recognized the importance of environmental research and decided to compile a work plan for environmental research. The Forest Research Institute has been charged with the coordination of the work plan.

The objective of the environmental research work plan is to develop—according to the demands and possibilities—and to harmonize the environmental research carried out in the institutions of the Ministry of Food and Agriculture. An important principle is that the environmental research should be linked with the actual research of production; be an inintegral part of it, that is to say the environmental consequences of the development of production have to be examined in all cases of production targets.

Some research themes which were proposed to be involved into the environmental research programs of the Ministry of Housing and Public Construction (National target program entitled "Optimal Development of the Human Micro- and Macro-Environment") and the Hungarian Academy of Scences (main research program entitled "The Protection of Man and His Natural Environment"). Thus the survey and coordination of the environmental research and the improvement of its information flow among the institutions of the Ministry of Food and Agriculture become more possible.

Until 1976 the coordination will be carried out on the basis of the responsible institutions' research reports having already been planned within the framework of other target programs and working plans. That is to say environmental research will separately be dealt by the different research programs, so that the information will be made possible.

The initiative program, which will be valid until 1976, contains the following scopes of duties and groups of themes:

ELABORATING DIRECTIVES FOR ENVIRONMENTAL MANAGEMENT
Examining the social demands on the environment
Evaluating and utilizing the potential conditions of the landscape
SOIL CONSERVATION
Examining soil pollution
Examining the soil damaging effects of irrigation and mechanical cultivation
Research for preventing soil erosion
WATERSHED PROTECTION
Influence of forests and silvicultural measures upon the water balance, water quality and oi
GENE-RESOURCE PROTECTION
Protecting the gene resources of cultivated plants
Protecting the gene resources of the natural flora
Protecting the gene resources of the wildlife and the domesticated animals
PLANT PROTECTION
Examining the environmental effects of plant protection
Research on methods of plant protection with selective chemicals

AIR PROTECTION

Examining the air pollution and its cleaning by biological means

Examining the influences of air pollutants upon the biosphere

ENVIRONMENTAL IMPROVEMENT AND PROTECTION IN FORESTRY

Elaborating the afforestation and tree planting operations on poor sites

Examining the environmental aspects of wildlife management

Improving welfare forestry

ENVIRONMENTAL IMPROVEMENT AND PROTECTION IN HORTICULTURE

Developing the green areas of downtowns

Examining the internal changes in fruits caused by the chemization of the horticultural production

ENVIRONMENTAL PROTECTION IN ANIMAL HUSBANDRY

Examining the environmental and hygienic effects of animal husbandry

Examining the utilization possibilities of by-products connected with animal husbandry

ENVIRONMENTAL PROTECTION IN FOOD INDUSTRY

Investigation of the pollutants influencing the food quality and elaborating the technology of their removal

Examining and decreasing the polluting emissions of food industry

GENERAL AND SUPPLEMENTARY THEMES

Address of the author:
Prof. Dr. B. Keresztesi, general director,
Forest Research Institute
1277 Budapest 23
Pf. 17.

SILVICULTURAL EDUCATION AND RESEARCH AT THE UNIVERSITY OF FORESTRY AND TIMBER INDUSTRY, SOPRON

ANTAL MAJER

Two third of Hungary lies in the zone of Southeastern European oak forests, one third in the Middle-European broad-leaved forest belt. On her plains the forest steppe and pedunculate oak, on her hills hornbeam-oak forests and on her mountains beech forests are typical associations.

It is not accidental, that two more and more differenciated trends are present in our silviculture, education and research, similar to other countries in Europe. On the hilly country and mountains (twothird of our forests) natural silviculture, on plains plantation silviculture is typical.

1.

For 165 years we teach silviculture on academical level. In higher forestry education forest vegetation and silviculture had always a great importance. According to the requirements this discipline has been differentiatated in education, too. Special knowledge in the field of silviculture is tought in the Departments of Silviculture and Afforestation.

Four semesters of basic studies are spent at the Departments of Chemistry, Forest Botany and Soil Science, and one semester (dendrometry) at the Department of Forest Management. In the 3–4th year 2 semesters deal with silviculture and afforestation, then in the 10th semester with forest selection, forest landscape planning and environment protection.

At the Department of Silviculture students are acquainted with ecological, phytocoenological, typological and stand structural characteristics of forests. Silvicultural methods are introduced by methods of regeneration and tending and are followed by cultivation of coppice and conversion of degraded forests. Silvicultural tasks are discussed separately for our main forest species. Finally the increasing public welfare role, esthetics of forest and environment protection are tought.

Afforestation includes seed management, plant production, planting and afforestation methods, waste land, sand, alkaline soil and peatland afforestation techniques, as well a irrigation system, pasture—field protecting- and roadside afforestation.

Among biological subjects the Departments of Forest Protection and Wildlife Management supplement education of silviculture. Differently from similar European institutes, at our university engineering-technical subjects are tought more intensively. From these subjects geodesy, forest utilization, forestry machinery and forestry transport help to teach silviculture.

2.

In Hungary the Department of Silviculture was the birthplace of forest research.

Since the middle of 19th century professors of Forestry Academy urged an organized start of forestry research, which came into being in 1898. For a half century heads of Department of Silviculture (Jenő Vadas, Gyula Róth, and Pál Magyar) were in charge of the Forest Experiment Station, which at the beginning worked at the Forestry Academy in Selmecbánya, later as the Forestry Institute and since 1933 as Forest Research Institute. In 1899 its official journal Erdészeti Kísérletek was started.

Forest research was separated only 1947 in Sopron, as Forest Research Institute, later, since 1949 in Budapest it was formed into Scientific Forestry Institute. So forest research left the Forestry High School since 1952. Teachers of the university, especially specialists of silviculture and afforestation can not be devoid of experimental and research work; they traditionally follow scientific activity, the results are given in the official journal of the university (Erdészeti és Faipari Egyetem Tudományos Közleményei—Scientific publications of the University of Forestry and Timber Industry) and other periodicals, books and lecture notes. Published works verify, that teachers of the Departments of Silviculture and Afforestations take their share in research, too.

3.

Nowadays silviculture and silvicultural research are characterized by two opposite trends. One considers forest as an ecological and phytocoenological unit, ecosystem with particular ecology, as an anthropobiogeocenosis or as a dynamic ecosystem; the other having wood production in view, aims on tending and selecting.

Research fields of the Department of Silviculture are: determination and classification of Hungarian forest ecosystems and their silvicultural relations. In the last decade we worked out and published a particular forest-type system. Site relations of forest types and site-classificating methods based on forest types were made known. Regeneration experiments of more important forest ecosystems were established. Method of forest type mapping was developed on 4 model areas.

Otherwise about 160 long-term experimental areas of tending were established, among these 2 fifty years old tending experiments were reconstructed. For stabler foundation of selecting we worked out morphological and physiological characteristics of selected trees. Determination of stand structure indexes were made more accurate and, we worked out tending models for our more important forest species. Investigations were done on the following fields: utilization of biological automatization following natural succession, protection of human environment as well as possibilities and methods of formation of forest ecosystems ensuring natural selfregulation.

The Department of Afforestation successfully studies ecological effects of agricultural shelterbelts and verified their favourable influence on agricultural crops. They worked out planting and tending methods of agricultural shelterbelts, as well as procedure of peatland afforestation.

On other fields they succeeded in selection of tree and osier willows. In the fields of nursery production they introduced new methods of production of ball plants.

In the field of landscape planning and environment protection investigations lead to aspects of forest parks, recreational forests, forming protectional sheltermelts and management problems of esthetical and preservation areas.

Address of the author:
Prof. Dr. A. Majer
University of Forestry and Timber Industry
9400 Sopron

SILVICULTURAL RESEARCH IN THE FOREST RESEARCH INSTITUTE

REZSŐ SOLYMOS

Silvicultural research is conducted in many fields in the Forest Research Institute. The start of this work coincides with the beginnings of forest research in Hungary. The present research activity bases on the results of more than 75 years, the aims of which were evolved in connection with the solution of the major tasks in forest and timber economy of the country.

The timber demand of Hungary cannot be met by the forests of the country. Great bulk of the economically unfavourable timber import is coniferous timber. Regarding future needs, it is unlikely that the timber needs may be covered by home production. We have, however, considerable possibilities to influence the quantity and structure of timber imports positively. Silviculture and naturally also silvicultural research has an important role in this respect.

One of the main tasks of our silvicultural research is the *determination of the site conditions of our forests*. This task means wide-ranging research activity, due to the extremely variable soil, geographic and climatic conditions of the country. According to this the great number of species is typical for our forests. Therefore site research in the Forest Research Institute is concentrated on the survey and classification of the site conditions of the country, and on the determination of the site requirements of the main tree species. In the last years the Institute worked out a uniform system for site evaluation, which serves as basis for the determination of the suitable tree species and also for different silvicultural methods. The selection of appropriate sites for fast growing species, as conifers and Euramerican poplars was carried out by this method. Thus it became possible to decide that the ratio of conifers may be raised from 10 to 20 per cent. Forest fertilization is linked with site research as well, notwithstanding the fact that due to scarce precipitation and low air humidity our possibilities are quite restricted in this field.

Yielding capacity of our forests is to be increased by the *selection and breeding* of varieties with better quality and volume yield. This important branch of silviculture brought considerable results up-to-date mainly in the field of conifer, poplar, willow and black locust breeding. State recognition of improved varieties started also forestry in the last years, which yields official, moral and material appreciation for the scientists too. The Institute introduced a number of improved poplar, willow, black locust and coniferous varieties the state recognition of which has already happened.

The necessary measures for the use of the improved material in practice were taken. Silvicultural research provides the basis for the modernisation of our *forest propagation material* production. Methods for producing Scotch pine improved seed were worked out by the institute, the result of which will secure the supply of all Scotch pine afforestations in the country with high quality planting stock in the near future, The necessary cutting quantity for establishing Euramerican poplar stands is lately under the guidance und supervision of the Institute. For planting only material of known origin may be used. Our researches in the field of introducing new nursery methods lead to the practical application of the "cold bed" method. Actually research activity is concentrated on the economical production of large-sized plants with covered roots, to achieve the prolongation of the period afforestation during the whole vegetation period, and to minimize the necessary tending in plantations.

Our forest research activities serve not only the increasing of volume and value but also the improvement of feasibility of timber growing. Rationalization efforts are undertaken in all fields of silviculture. Recently researches are intensified in the field of *afforestation and tending*. In the last quarter of century about 800 thousand ha of afforestations were carried out.

In these young stands already tending cut is necessary. The tending of thichets with 10–14 thousand trees per hectare causes big problems for our silviculture. The removed timber is only partially suitable for utilization; due to low level of mechanisation manpower demand is very high. In order to reduce this problem the maximally possible increasing of planting space is strived after. The experimental results are promising in practice only 60–70% of the earlier plant number is used. Following the general introduction of improved propagation material in practice, further reductions are planned, the justification of which is proved by research.

I intend to deal more detailed with the tending and yield researches conducted in the frame of silvicultural research in the Forest Research Institute, as a considerable propagation of our distinguished guests is concerned with these themes in his work. On the other hand this theme is also the special field of research of mine. I am participating in the activities of the IUFRO Working Party concerned in these problems, and I have established in Hungary internationally coordinated experiments as well. The more detailed approach is justified also by the fact, that due to the age grouping of Hungarian forest, tending will be one of the central tasks of silviculture.

Tending and yield researches are conducted in close connection in the Forest Research Institute. Experiments in this theme were begun by our antecedents at the end of the nineteenth century. Because of the production and economic situation and of two World Wars, intense research work could start by the end of the fifties only. The long-term tending and yield experiments have provided the basis of regular research, the establishment of which started in 1961, based on up-to-date methodics. Notwithstanding the fact, thet opinions about long-term experiments were at that time not at all uniform, we considered these as the most reliable method for determination of the yield of the main tree species, of the growth of forest stands and of the effect of tending operations on yield. The research results of the recent ten years justified this view and proved that long-term experiments are a valuable help for up-to-date research as well.

At present more than 2,000 long-term *tending and yield* experiments are registered, covering the whole country. The species proportion corresponds roughly that of the whole forest area. Presently already second surveys are undertaken in these stands, the data of which will be utilized for evolving *long-range plans* for our forestry.

In the first period of research mostly *yield* data were gained after the first survey of the experimental fields. These differ from earlier research results mainly in that respect, that the aims of forest tending were better taken into consideration and with the help of these data we gained concrete figures for tending, thinning operations. First of all I have to mention the new general and local yield tables, which filled a longfelt gap. The yield of our stands was determined earlier from the yield tables of *Greiner,* constructed in 1886, and partially from the tables of *Schwappach*. Both could not fulfill the needs of silviculture, therefore the demand for new, Hungarian tables was growing. Based on the first data survey of our long-term experiments until 1972 a total of 18 general and local yield tables were constructed for Scotch pine, Corsican pine, Norway Spruce, Douglas fir, beech, pedunculate and sessile oak, Turkey oak, red oak, hornbeam, various Euramerican and native poplars and alder.

It is visible from these yield tables that the Hungarian conditions are in general more favourable for timber growing as the European average. It should also be mentioned that in the first period of research, i.e. until the middle of the sixties, the home-made volume tables were finished as well, providing much more precise data than the ones of *Schwappach*, the latter being in use in the past. These tables are used both in the practice and in research for volume determination. The same refers to the new yield tables, which are used both by inventorists and by professional silviculturists.

The basis for *tending research* was also laid down by the results of yield investigations. Tending research concentrated on the establisment of methods which implement the attaining of the production goal with minimum expenses, the whole production cycle in view. Therefore the timing, necessary frequency and intensity of tending operations is investigated, and suitable technologies are worked out to create maximal possibilities for mechanization.

From among the results of the recent ten years the elaboration of the *forest tending system, covering the whole production cycle* should be mentioned. In the scope of this work up-to-date principles of our forest tending tasks were determined, which were illustrated numerically with standard tables.

These standard tables are already available for all main tree species. The construction of the tables was made by the Institute. According to these principles the first tending operation should be carried out as early and as intensively as possible, in order to increase the period until the next thinning, and to raise the diameter and utilization possibilities of the timber removed at later intervals. The reduction in the number of tending operations should on the other hand contribute to the reduction of production costs of timber. Thus, instead of the older principle of "early, often, moderate" interventions we are tending "early, rarely and strongly". The standard tables for tending were constructed according to this principle. Depending on the expectable yield tree yield groups were created, with two yield classes in one yield group. The number and intensity of tending as well as rotation age was determined separately for these groups, which makes the further consideration of economic aspects possible. The standard tables contain the number and timing of tending, the stem number, basal area, average diameter and height of the main (remaining) stand, and finally the average stem distance.

Keeping optimal stem numbers, taking into consideration the production goal, was strived after. The data of long-term experiments, collected for ten years, are in this respect not suitable for drawing clear conclusions. The data were complemented with the yield and stand structure figures of excellently yielding sample plots, and the optimum stem number referring to species age and site was determined by optimum calculation. The expectable volume and average diameter for the possible stem numbers and for the age classes was determined. The multiplication of these figures was used for the construction of range of values. The stem number with the culminating value was accepted as optimal.

The research work will be continued in the next period. Our yield tables will be completed with assortment tables and the figures of the yield tables corrected based on repeated stand surveys. Further development of mechanization and simplification of tending are considered as additional tasks of forest tending research. Statistic methods and electronic computers are extensively applied in research. The further development of our methods is also foreseen.

Finally *forest protection research* should be mentioned from among silvicultural research activities performed in the Forest Research Institute. The role of these themes increased rapidly with the raising proportion of poplar and conifer afforestations. We have an extensive network for observation; with the help of the light traps regular forest are given for the expectable appearance of pests. Not only the biology of damaging organisms but also the biological and technical methods of control and prophylaxy of damages are investigated. Our native species (oaks, beech, hornbeam) are less damaged by pests. The protection of fast-growing poplars and conifers are, however, providing manyfold tasks for forest protection research.

Silvicultural research will be further developed in the future, taking into consideration also the aspects of recreation and of protection besides of the timber-producing function of the forest. We intend to serve multiple-use forestry with our work, in order to meet the growing and changing social-economic demands as completely as possible.

Address of the author:
Dr. R. Solymos, head of department
Forest Research Institute (ERTI)
1277 Budapest 23
Pf. 17.

PUBLIC DEMANDS ON FORESTS IN RELATION TO FOREST WILDLIFE

JUDITH J. ROWE

Forests are the climax vegetation in climates which are not subject to extremes of temperature and/or light conditions. It is reasonable to assume that they will continue for the foreseeable future to occupy a large proportion of the globe, despite increasing human demands for space for agriculture and for urban development and its support services—particularly water and communications. Animals and nontimber plants are inevitably associated with any forest ecosystem (biogeocoenosis) whether natural or artificial in origin and this forest wildlife is affected by any demands made on the forest environment. Before I review the past and current interactions of forest and wildlife in terms of human demands, I would like to make the point that one of the inherent roles of the forest, often taken for granted by the public at large, is the important contribution that is made to maintaining global climates and environments. In the absence of considerable technological developments in global atmospheric control, this maintenance of global climates in probably an essential role and would produce an immediate demand should forested regions be deforested on a large scale.

One of the biggest demands on the forest is for living space. In many countries, the forest itself can be a source of food and shelter for small native populations and man can be regarded as part of the forest ecosystem. In many situations, for example in countries as varied as India, Cyprus, Brazil and Africa, this creates problems for both forest and wildlife management. Shifting cultivation may be irretrievably destructive to forests through its effects on the soil as in parts of Africa (*Curry—Lindahl,* 1967). The wildlife may have to contend with hunters and poachers and compete with grazing domestic stock as in India (*Raghaven,* 1968). On the positive side it can only be suggested that the abandoned clearings and forest edges may be enriched for wildlife by virtue of the increased numbers of ecological niches made available.

For many centuries in Europe and in other continents, man has shifted out of the forest—though this has more often been by clearing the forest than by being able to find non-wooded regions. Currently, in countries such as Sweden and Britain, there is a growing demand for supplementary living space within the forest as a form of recreation (*Spender* and *Sidaway*, 1972). This is a reversal of the centuries old trend which has taken human populations out of the forest. A similar form of demand can be seen in America where summer forest camps have long been established. The structure of the forest, its species composition and age-class, in the vicinity of each dwelling can modify the satisfaction of the recreationist and create problems in forest management. The local wildlife, be it animal or plant, appears to add to the quality of the experience by its existence. It may be that wildlife management problems of the future lie in deciding how much of which species of the regional wildlife can, or should be, increased in quantity to satisfy the demand inherent in the nature of the experience. Both forester and wildlife manager would then be involved in the habitat manipulations that may be required to produce a product that ensures a high return on the capital invested.

Subsistence-level inhabitants of forests are to variable degrees dependent for protein on the meat produced by forest wildlife. Meat harvesting has often been an important by-product of the forest. In Britain, for example, the price of venison per kilo has increased nearly ten times in as many years. It is possible that the world-wide demand for protein will result in an increased interest in harvesting local forest wildlife as is already being done in the savannas and plains of Africa. This is a type of demand that can entirely change the forest environment since the quantity of beasts becomes important and wildlife management must inevitably be concerned with habitat manipulation to increase carrying capacity. An interesting possibility for avoiding the conflicts that must than inevitably aries between forest and wildlife managers can be seen in the research being done on farming red deer (*Bannerman* and *Blaxter*, 1969).

A similar solution developed when demands for living space and timber from Canadian forests began to outweigh the importance of the original forest product which resulted in much early exploration. This was the production of prime quality furs which are now produced in farms for animals such as mink and fox, thus avoiding the need to manage wild animals for sustained, consistent high quality yield. Furs are still in demand and still a source of forest revenue, for example in parts of South America. This continues despite the risk that the exploitative response to the demand without research-based management puts the larger predators concerned at risk of extinction.

It seems that when meat and fur are in high demand, it is economically and ecologically sounder to look at alternative methods of supply than to unbalance a forest ecosystem by over-loading it for the production of one or two wildlife species. It is not possible to produce viable substitutes in situations where hunting, for meat or fur, has become ritualised over a period into a form of recreation. At best, a potential substitute or training aid becomes a sport in its own right—as has clay—pigeon shooting. Where forest wildlife species are the object of the hunt, wildlife or game management has all too often become divorced from forest management despits its dependence upon the forest environment and the traditional forms of conflict between timber and wildlife production have developed. Two main interactions between wildlife and forests have received most attention in regions where timber production is the main forest objective. The first is the damage done by animals to trees and the second the importance of certain wildlife species for sport. For non-game species, damage prevention has been simple in concept and all too often unselective in application. There has been a tendency to kill or to fence out rather than to look at the causes of damage and the possibilities of slight silvicultural or forest management modifications to reduce the risks of damage. There has also been remarkably little attention paid to quantifying predictive methods for assessing the likelihood of damage in given situations.

It is where game species are the damaging animal that the conflict between forest and wildlife management is most persistent (*Daburon*, 1968). This is particularly so where home management techniques aimed at producing quantity have become hallowed by tradition and the ability to question the continuing validity of the underlying assumptions appears to have been lost by wildlife managers. In such cases, extremes of conflict can arise. For example, in the Scottish Highlands, management techniques were developed to increase red deer stocks to meet a new demand in the last century. Management to increase and maintain high numbers became a tradition on the treeless deer forest for a particular form of sport-hunting. Numbers of deer outwith plantations in these areas are too high to be compatible with the young plantations which have more recently become an important form of land-use of the region. The red deer on relatively impoverished heathlands with little tree shelter does not compare with the same animal at lower density in forest habitats for a trophy or in venison value. The continuance of this tradition of wildlife management lies in the fact that it is linked to a particular form of sport-hunting—red deer stalking—for which there continues to be a high demand from a small and specialized section of the public. The only current justification for the numbers lies in the high value of venison, though it is questionable whether the intensity of culling, particularly of the female stocks, maximises venison production.

It is not only timber production that may suffer from over-production of game animals. In the Swiss National Park, for example, high alpine meadows are being qualitatively altered in plant species by the summer grazing pressures due primarily to an expanding population of red deer. This situation is complicated by the fact that the animals are wintering elsewhere during the shooting season and are not under the direct control of the National Park's staff.

A third example, again using red deer, concerns the difficulties of regeneration of high altitude forests in areas where avalanche and erosion control by woodland should be of paramount importance. Concern over this has been expressed in such diverse forest ecosystems as Austria (*Mayer*, 1973) and New Zealand. In the latter, much of the problem stems from the ill-informed ecological engineering attempted by earlier wildlife managers. A number of introductions of various species of deer and rodents have playned havoc eith the local wildlife and the forest ecosystems. In parenthesis, it can be added that there has been, and still is, a regrettable tendency among wildlife managers and foresters to look at species from foreign environments as being potentially better producers of sport or meat than the native species. More recently there has been a tendency on the part of wildlife managers to look at techniques for manipulating the habitat to make the most of local stocks: this technique in itself holds the seeds of conflict with forest management unless both forester and wildlife manager are co-operating to the same end.

Sport-hunting in its various forms continues to be in high demand by a specialist minority of the public. It is questionable whether the revenues accruing from such sport counterbalances the costs of its interference with forest management and the damage that may result from over-stocking. Attempts to raise the carrying capacity of a woodland by artificial means have often preceded adequate evaluation of the natural carrying capacity of the environment and of the factors that are actually limiting. Research on the ecological aspects of game production (*Dzieciolowski*, 1970) is vital of wildlife in general and game in particular are to be meaningfully managed as part of the forest ecosystem to meet particular demands or to allow for changing demands.

The need for this approach to wildlife management is particularly relevant in view of the current levels of demand for forest recreation. This has increased at a greater rate in the last decade or two than any other demand on the forest resource—including the demand for wood. The problem that this is causing forest and wildlife management is illustrated in an interesting survey among foresters of British Columbia (*Bunell* and *Dumont*, 1973). They suggested that the problems resulted from increasing intensive forest management for timber combined with the increasing public pressure for forest recreation. They attempted to determine the role played by wildlife in forest managements policies. The results showed that foresters recognised wildlife as a significant resource mainly for its recreational and aesthetic potential. The amount of conflict was increasing and likely to continue to do so as public demand forced increased consideration of wildlife in forest management policies. The survey showed that a training for timber production was inadequate when management for other products of the forest ecosystem was required. It also appeared that difficulties arose for foresters in putting into practice wildlife management techniques already available for reducing crop losses: relatively little active manipulation of forest or wildlife was carried out for this reason, although crop losses were described as a major problem.

It can be inferred from the results of the survey that the foresters concerned were also affected by another relatively recent influence on forest and wildlife management—the recognition of the principle of conservation of natural resources.

A great variety of attitudes and methods of approach to conservation have developed in Europe (*Duffey*, 1969) and in the rest of the world. Broadly speaking, two extremes of attitudes seem to exist. On the one hand it is argued that the objective of conservation is the maintenance and improvement of the human environment. On the other hand it is considered that it is the maintenance of "natural" ecosystems and of the species of plants and animals that comprise them, that is the prime objective. Propenents of both attitudes agree that human management of any environment or ecosystem must be based on sound ecological understanding of the factors operating, particularly at critical levels (*Desmann*, *Milton* and *Freeman*, 1973). Many forest management systems are inherently conservation oriented—indeed much of the impetus for a recognition of conservation has been stimulated by foresters (*Riney*, 1970).

The demands made by conservationists on forest and wildlife managers can be simplified into two categories. The first concerns particular communities or species of plants and animals whose existence may be jeopardised by forest management techniques locally or nationally. These are usually relatively simple problems to solve provided first, that there is general agreement on the value of the species to be preserved on an international, national or local scale, and second that the appropriate ecological knowledge of the critical factors for the maintenance of the species concerned exists. The recent development of Fauna Priority Areas in Australian State Forests (*Christensen*, 1973) is an example of a generalised approach to this sort of problem.

The second category of problem is more complex because it involves that elusive factor—the quality of the environment. Foresters are increasingly aware that forests have an inherent quality aesthetically which can be improved or diminished by the way in which standard forest operations are carried out. To this quality, forest wildlife makes an important contribution merely by existing as part of the forest ecosystem. I suspect that it was this aspect of conservation which the Canadian foresters referred to as the aesthetic potential of wildlife.

Before such recognition of quality considerations became widespread, many public demands for recreation in any form could largely be met by increasing quantity. Now there is an increasing demand that the quality of the environment is not impaired by such an increase (*Webb*, 1968). Among both wildlife and forest managers there is an increasing demand for methods of evaluating existing quality and for the management tools to allow prediction of the influence of various management options upon quality to be measured.

Various systems of classifying and measuring have been attempted. It has, for example, been suggested that the visual attributes of a landscape should be divorced from its ability to support recreational facilities (*Hamill*, 1971). However, the two necessarily interact in some situations where high landscape values can focus demand for recreational facilities on an area regardless of its ability to support such facilities.

In France the problems of changing human demands have been described by *Betolaud* (1968), who places considerable importance on assessing the forest and its management in terms of its influence on regional landscapes. In highly industrial countries, this is partly due to great increase in car ownership and in leisure time (*Burger*, 1967). There is increased use of natural landscapes by people driving for pleasure and this may form a high proportion of the recreational experience of casual visitors to forests.

In British State Forests, these demands for facilities for non-specialist recreation, for example day visitor car parks and picnic sites, is taken into account in forest management (*Spencer* and *Sidaway*, 1972) and in planning (*Grayson, Sidaway* and *Thompson*, 1973.). This form of demand is catered for rather than more specialist types of recreation since it shows continuing growth, a low cost in terms of modified forest management for timber and a relatively high return from the facilities provided.

It is a form of demand that has, at present, relatively little impact on wildlife since the bulk of the visitors use the forest during the time of day in which the animal life is least active. Such visitors are also relatively easily channelled onto forest walks and trails where their impact on the vegetation can be absorbed. The situation reported in Japan (*Kato* 1967) was rather different: increasing mass use tended to destroy elements of the original attraction before the dangers of such an impact was recognized.

This danger of expecting a forest to continue to absorb casual visitors without management guidance has recently been the subject of considerable research. Concepts of carrying capacity for managing recreation have been developed (*Wagar*, 1964). It is important to devise ways of measuring the interaction of site, people using it and the effects of management techniques on both people and site. Wager suggested that ecological variables would show when changes in quality and/or quantity occur but stressed that a management decision on what constitutes an unacceptalbe loss or rate of change in quality was still required. This type of investigation has been begun in Britain (*Bayfield*, 1973) and it is clear that measurements of carrying capacity—ecological, physical, perceptual or economic—require considerable sociological and ecological research. Knowledge of the behaviour of people in response to physical or perceptual crowding is important for the development of management techniques that will keep usage below the level at which the ecological carrying capacity is reached.

Although in Britain at present demand for casual recreation can be catered for without involving wildlife, it is apparent from forest centres such as Grizedale in the Lake District that the presence of wildlife adds immeasurably to the enjoyment of the public. The provision of facilities for viewing wildlife in the wild (not in enclosures) increases the level of demand and provides additional techniques for spatially zoning specialist and non-specialist forms of recreation and timber production to keep conflicts to a minimum.

In less highly industrialized countries or regions, more specialist forms of recreation have greater weight. The increasing demand for tourist facilities involving active recreation such as hunting, shooting, fishing and photography is one example (*Riney*, 1968). In Britain, specialist minority activities such as orienteering and pony-trekking have been increasing in popularity. The pursuit of specialist natural history interests has always been a feature of these minor demands on British forests. It is possible that forest management will increasingly be required to balance conflicts arising between different forms of recreation rather than with direct conflicts between timber production, recreation and wildlife management. The decrease in areas of true wilderness, much of which is forest land, and the increase in road density and accessibility means, for example, that casual tourists are likely to conflict with individuals and small groups who value wilderness for its own sake (*Merriam*, 1967).

The economics of managing forest and wildlife to supply recreational demands is outwith my competence to explore. It is unrealistic, however, to consider these demands without being aware that the majority can be evaluated by the same type of cost/benefit analysis as is applied to timber production. Demands in the field of conservation and environmental quality are less susceptible to this approach and the need for a useful measure of their economic impact to assist management decisions remains high (*Grayson*, 1972, *Hopkins* et al., 1973). A number of foresters have queried whether the provision of facilities should be the responsibility of the industry, government or the recreationists themselves.

It should now be apparent that considering the requirements of the public in relation to the forest and wildlife problem emphasises the essential interdependence of both. The ecosystem concept (*van Dyne*, 1969) applied in both forest and wildlife management has much to recommend it but those who expect this to be a simple path to a more unified management should remember the complexity that is inherent in a superficially stable, self-perpetuating ecosystem (*Elton*, 1966).

Mayer (1972) and *Clauser* (1972) have both emphasised the dangers inherent in increased mechanization if the increasing variety of demands on forests in the human environment are ignored. *Manning* (1970) in America has produced similar warnings on the importance of foresters increasing the scope of their knowledge to make environmental decisions involving disciplines at present outwith their competence. Wildlife managers are faced with similar problems. *Crissey* (1971) summed up the dilemma by suggesting that the object of wildlife management should be to manage the resource to provide benefit for people rather than to maintain wildlife populations and their environment as an end in itself. It is essential for wildlife managers to re-evaluate current techniques in the light of current demands as, for example, has been attempted for the usefulness of re-seeded forest clearings in America (*Larson*, 1967). Wildlife managers must also consider whether maximum attention in research should not now be paid to plant and animal species which enhance the quality of the forest for non-specialist recreation rather than to continuing to emphasise the production, indeed the over-production, of game species.

The way is also clear for wildlife managers to develop techniques which can be used to manage and modify the demands made on the forest. The critical factors limiting any wildlife species must be elucidated for realistic management: it is insufficient to specify the general ecological attributes of suitable environments and expent forest management to produce adequate habitats. Foresters need to be aware of the environment that forest management for timber production produces and of the impact of increased mechanization, use of chemicals or changes in felling policies on wildlife. Foresters should still be prepared to use such techniques selectively and judiciously—they sould not be prepared to abandon them at any faint suggestion that their use detracts from forst environments.

Increasingly it seems likely that the forester will need a sufficient background of knowledge in such fields as recreation, sociology, landscape architecture and wildlife management as well as economics to appreciate the importance of the forest in maintaining wildlife, the influence of the forest on regional landscapes and to evalute the demands for racreation or various kinds within a forest. In many areas itis possible that timber will become one of the by-products of the forest environment and its production a system of maintaining the quality of theenvironment rather than the main object of the forest. This attitude and type of multiple use may be easier to achieve in countries that lack highly developed traditions of forest and game or wildlife management. On the other hand, such countries are more likely to be involved with the problems of managing a human population which is ecologically dependent on the forest for the necessitier of life. In the immediate future, research involving co-operation between foresters and their colleagues in these other disciplines is an essential requisite for establishing mutual understanding of the problems and for producing solutions in a common language which can be incorporated in forest management and its training in the future.

References

Bannerman, M. M. and *Blaxter, K. L.* (1969): The Husbanding of Red D:er. Rowatt Research Istitute, Aberdeen.

Bayfield, N. G. (1973): A Review of Problems and Progress in Site Management Research. Recreation News Supplement *9*. 3—5.

Betolaud, Y. (1968): Forêt et civilisation urbaine. Revue for. française 9: 535—649.

Bunnell, F. and *Dumont W. E.* (1973): Foresters, forestry and wildlife For. Chron. 49 (2):

Burger, D. (1967): Research Problems concerning Forest, Fauna, Flora and Outdoor Recreation in the Netherlands IUFRO XIV. Congress Munich VII: 154—182.

Christensen, P. (1973): Focus on a new concept in forestry — Fauna Priority. Forest Focus 10: 2—20.

Clauser, F. (1972): Silviculture and Conservation of Nature in Europe. Council of Europe, Strasbourg.

Crissey, W. F. (1971): Some thoughts on Wildlife Research and Management Objectives. The Wildlife Society News 134: 27—28.

Curry—Lindahl, K. (1967): Recreation and Wildlife Research in tropical forests. IUFRO XIV. Congress Munich VII: 93—124.

Daburon, H. (1968): L'equilibre sylvocynegetique Rev. for. franc. 9: 567—570

Dasmann, R. F., Milton, J. P. and *Freeman, P. M.* (1973): Ecological Principles for Economic Development. Wiley.

Duffey, E. A. G. (1969): Wildlife Conservation in Europe. SPNR Handbook 16—51.

Dyne, G. M. van (ed.) (1968): The Ecosystem Concept in Natural Resource Management Academic Press.

Dzieciolowski, R. (1970): Food carrying capacity of forest environments as an ecological problem Sylwan CXIV. *(11)*: 1—17.

Eiberle, K. (1973): Über die Abhängigkeit der Tiergemeinschaften von der Vegetation. Wald und Wild: Suppl. aux organes de la Société forestière Suisse No. 52: 43—67.

Elton, C. S. (1966): The Pattern of Animal Communities Methuen.

Grayson, A. J., Sidaway, R. M., and *Thompson, F. P.* (1973): Some Aspects of Recreation Planning in the Forestry Commission: Forestry Commission (UK) Res. and Dev. Paper 95.

Grayson. A. J. (1972): Valuation of Non-Wood Benefits Forestry Commission (UK) Res. and Dev. Paper 93.

Hamill, L. (1971): Classification of Forest Land for Recreational Potential and Scenery For. Chron. 47: 149—153.

Hopkins, F. S. et al. (1973): Planning for the future in outdoor recreation: an economic viewpoint. For. Chron. 49: 71—75.

Kato, S. (1967): Use of the National Forests for Recreation in Japan. IUFRO XIV. Congress Munich VII: 393—400.

Larson, J. S. (1967): Forests, Wildlife and Habitat Management — a critical examination of practice and need US For. Serv. Res. Pap. SE — 30.

Manning, G. H. (1970): Foresters and Environmental Decisions. For. Chron. 46: 387—391.

Mayer, H. (1972): Vom Wesen waldbaulicher Arbeit heute und morgen. Forstwissenschaftliches Zentralblatt 91 (4/5): 191—200.

Mayer, H. (1973): Möglichkeiten und Grenzen der Schalenwildhege im Gebirgswald. Wald und Wild: Suppl. aux organes de la Société forestière Suisse No. 52: 43—67.

Merriam, L. C. (1967): Wilderness Studies in the Northern Rocky Mountains, Montana, USA. IUFRO XIV. Congress Munich VII: 183—199.

Raghaven, S. (1968): Wildlife Management Trends in India Ninth Comm. For. Cong. 1968. Vol. 10., 265—280.

Riney, T. (1968): Forestry and Wildlife Management Ninth Comm. For. Cong. India

Riney, T. (1970): Wildlife Conservation and Management. Unasylva 24 (99): 15—17.

Spencer, J. A., and *Sidaway, R. M.* (1972): The Special Contribution of Forests and Woodlands to Recreation in an Industrial Society. Forestry Commission (UK) Res. and Dev. Paper 92.
Wagar, J. A. (1964): The Carrying Capacity of Wildlands for Recreation. For. Sci. Monographs 7: 1—24.
Webb, W. L. (1968): Public Use of Forest Wildlife: quantity and quality considerations. J. For. 66 (2): 106—110.

Address of the author
J. J. Rowe, wildlife research officer
Forestry Commission
Forest Research Station
Alice Holt Lodge
Wrecclesham, Farnham, Surrey

FINAL COMMENTS AND CONCLUSIONS

DUSAN MLINSEK

The IUFRO Division, Site and Silviculture, held its 1973 meeting in Budapest. The meeting was arranged by the Hungarian Department of Agriculture, by the Forest Research Institute in Budapest and by the Faculty of Forestry in Sopron. The main topic of the meeting was:—
"Research, education and practice in silviculture".

This topic was not selected at random. There is an urgent need for research, education and practice to join together in a serious effort to promote the idea of the forest as an ecosystem. The concept of an ecosystem should no longer be treated as a mere slogan. The forest must not only be investigated, but also treated as an ecosystem. In these activities, silviculture and related interdisciplinary research in other branches should participate as much as possible. Often, the forest is proclaimed as being an ecosystem, but practice goes in another direction. The same frequently applies to research and practice, as shown by scholarly investigations of ecological principles and simple practical silvicultural techniques. Research, education and practice should proceed together in the same common direction; otherwise the forest will be exposed to even more serious dangers. It will persist under a constant menace like an organism filled with antibiotics. It is our duty to seek integrated ways within IUFRO so as to join silvicultural education, research and practice into a united and common approach. The meeting in Budapest provided an important contribution to this objective. The papers and resolutions included a multitude of stimulating suggestions. We express our thanks to the reporters for their efforts in defining new spheres of activity for the researcher, teacher and practical forester.

The meeting was followed by a number of instructive excursions. Our Hungarian colleagues, took great pains in showing and explaining their successes and problems. In Hungary, silvicultural research is greatly encouraged. This is shown by the enormous number of projects and by the enthusiastic and self-sacrificing efforts that have been made.

Here, middle-European silviculture is a reality. In many places we also saw the fruits of a successful "agrosilviculture", important for a country like Hungary. Considering the wood shortage and the struggle for an unspoiled environment, this example becomes more and more common, generally. Two different approaches are involved however, which are unlikely to be integrated. Both have to be proceed rationally, separately but in parallel, with mutual understanding. It is only by the separation of these two silvicultural concepts will the frequent misunderstandings that arise be removed at the scientific level. We have to maintain this attitude not only for scientific, but also for practical reasons:—

1. The circle of research workers in forestry is too narrow, the range of urgent problems too wide.
2. We cannot afford the freedom to waste time in solving artficially created problems.

3. We are members of one of the oldest international scientific unions which has been able to justify its existence with honour and success. This also defines our future obligations.

I wish to congratulate our Hungarian colleagues on behalf of IUFRO and all participants from abroad for their work and contributions to forestry. At the same time we thank our Hungarian friends for their exemplary organization of the meetings and for their wonderful hospitality.

LIST OF PARTICIPANTS

Dr. P. Abetz (G.F.R.)
J. R. Aldhous (England)
Prof. S. O. Andersson (Sweden)
Dr. E. Bauger (Norway)
P. Benda (Czechoslovakia)
Prof. Ing. H. Bezačinsky (Czechoslovakia)
H. Bryndum (Denmark)
Ing. M. Bubnjevič (Yugoslavia)
Ing. L. Chroust (Czechoslovakia)
Prof. Dr. S. Dafis (Greece)
J. Delvaux (Belgium)
Dr. Ing. A. Dokuš (Yugoslavia)

C. A. Drolet (Canada)
R. Dziecciotowsky (Poland)
Dr. Ing. G. Eckhart (Austria)
Ing. J. Enk (Austria)
H. Eriksson (Sweden)
Dr. F. Fischer (Switzerland)
S. Orlič (Yugoslavia)
Dr. H. Oswald (France)
Ing. J. Pakez (Czechoslovakia)
T. Paslawski (Poland)
Prof. Dr. J. B. Phillips (England)
Prof. Dr. K. Pintarič (Yugoslavia)
Prof. Dr. P. Piussi (Italy)
B. Piskun (Czechoslovakia)
Dipl. Ing. W. Rachyo (Austria)
Dr. P. P. Reid (USA)
J. Rowe (England)
Prof. Dr. F. Saatcioglu (Turkey)
O. Valkova (Czechoslovakia)

Dr. G. Gallagher (Ireland)
C. P. Goor (Netherlands)
Prof. Dr. M. Haugberg (Norway)
Prof. L. Heikurainen (Finland)
C. W. Holloway (Switzerland)
T. Korpela (Finland)
A. Kowalkowski (Poland)
Prof. Dr. H. Lamprecht (Switzerland)
Dr. H. P. Land (Austria)
Ing. L. Lehotsky (Czechoslovakia)
Dr. M. Leiskola (Finland)
Dr. L. Leyton (England)
Dr. N. Lust (Belgium)
Prof. Dr. J. May (USA)
Prof. Dr. H. Mayer (Austria)
Dr. J. E. Marion (France)
Prof. Dr. M. Miegroet (Belgium)
Prof. Dr. D. Mlinšek (Yugoslavia)
L. Oldenkamp (Netherlands)
Dr. E. Vestjordet (Norway)
Prof. Dr. M. Vyskot (Czechoslovakia)
Dr. K. Zukrigl (Austria)
K. F. Wenger (USA)
R. Sobczak (Poland)
L. Smelkova (Czechoslovakia)
R. C. Steele (England)
M. Swan (Ireland)

S. B. Schemnitz (USA)
Dr. G. Schuerholz (Italy)
Prof. Dr. H. Thomasius (G.D.R.)

HUNGARIAN PARTICIPANTS

Dr O. Birck
Dr. A. Bondor
Dr. Z. Borsos
Dr. E. Csesznák
Dr. Gy. Csontos
L. Dala
S. Faragó
Gy. Fekete
Dr. L. Halupa
Dr. Z. Járó
Prof. Dr. B. Keresztesi
P. Király
Dr. R. Kiss
Ass. Prof. Dr. F. Kopecky
Dr. Gy. Lengyel
Dr. A. Madas
Prof Dr. A. Majer
Cs. Mátyás
Gy. Mihályka
Dr. L. Papp
Dr. J. Páris
Dr. M. Simon
Dr. R. Solymos
Dr. I. Szodfridt
Dr. S. Tóth
Dr. F. Walter

TARTALOM — CONTENTS — INHALT — СОДЕРЖАНИЕ

Megjelent a Mezőgazdasági Könyvkiadó Vállalat gondozásában
Felelős kiadó Keresztesi Béla, az Erdészeti Tudományos Intézet főigazgatója
Felelős szerkesztő Mátyás Csaba
Műszaki vezető Korom Ferenc
Műszaki szerkesztő Müller Zsuzsa

*

Nyomásra engedélyezve 1975. VI. 24-én
Megjelent 700 példányban, 9 (A/5) ív terjedelemben, 27 ábrával

MG 2251-a-7400

75.3167.66-13-2 Alföldi Nyomda, Debrecen