

Tomasz MOKRZYCKI

**Effect of pine forest stand age on bark beetle communities  
(Coleoptera: Scolytidae) in Puszcza Białowieska**

**Abstract.** An ecological analysis has been conducted of *Scolytidae* communities occurring in a subcontinental (*Peucedano-Pinetum*) pine forest in different stages of succession. The analysis included determination of the species and quantitative composition, the structure of dominance and comparing the communities using a species diversity index.

INTRODUCTION

In production forests, the whole process of production is aimed at obtaining best quality timber in the shortest possible time. The consequences of such practices are usually adverse. The establishment of clear cuttings renewed with only one tree species and their subsequent cultivation lead to the formation of even-aged pine stands composed of one species. After the renewal, cultures of pine are formed, characterized by high stand density. Cultivation prevents other tree species (e.g. birch) from developing within the stand. The young stand and thicket are the following stages of succession, where the processes of tree separation are accelerated. In the pole wood stage, the density of canopies diminishes as a result of natural processes and thinning. The pine stand enters the stage of a mature phytocenosis.

The history of studies of *Scolytidae* and their relationships with the habitat and its succession is short. All the papers to date (KARPIŃSKI 1933, BAŁAZY et al. 1964, MICHALSKI et al. 1989) only present the species and quantitative composition of bark beetle communities without taking into account the succession of the forest stand.

Investigations of *Scolytidae* communities in Puszcza Białowieska date back to 1930's (KARPIŃSKI 1933). They comprised phytosociological description of all the habitats, including the fresh pine forest, and of the communities of *Scolytidae*



inhabiting them. These were analysed in terms of species and quantitative composition and vertical distribution.

In the period that followed there were no comprehensive studies concerned with *Scolytidae* communities occurring in pine forest stands in different stages of succession.

The aim of the present paper was to determine the species and quantitative composition of *Scolytidae* communities inhabiting a pine forest at different stages of secondary succession. Changes occurring in these communities were assessed, the structure of dominance was determined and the species diversity of individual communities was analysed.

#### AREA, METHODS AND MATERIAL

The study was conducted in the years 1984–85 in divisions 637 and 638 of Puszcza Białowieska in a subcontinental (*Peucedano-Pinetum*) pine forest habitat (MATUSZKIEWICZ et al. 1993). *Scolytidae* were caught into window traps. The traps were situated in five sites belonging to different stages of secondary succession:

1. 1-year-old pine culture established on a winter clearing
2. 20-year-old young stand of pine
3. 47-year-old pole wood with individual birch trees
4. 63-year-old pole wood with individual birch trees
5. 130-year-old mature stand of pine

There were 10 traps at each site, hung at a height of 2 m (1 m in the culture). Catches were carried out from April 1 to September 15. Traps were emptied every two weeks.

A total of 4224 *Scolytidae* specimens were collected, representing 22 species. The greatest number of species was recorded in the mature stand (1300), the lowest in the young stand (293). The species and quantitative structure of the *Scolytidae* communities is detailed in Table I.

#### *Scolytidae* communities

A 1-year-old culture of pine with stumps which have remained after winter clear cutting is a specific habitat, where species could be expected to live that are associated with older stands (they will attack stumps) and the young generation of pines (BRAUNS 1964, NUNBERG 1964). Unbarked stumps were inhabited by a *Scolytidae* community consisting of *Hylurgops palliatus*, *Hylastes ater*, *Hylastes opacus*, *Hylurgus ligniperda*, *Tomicus piniperda*, *Orthotomicus laricis* (the most numerous species). In contrast to the overground part, the underground part of a stump, including the roots, is characterized by balanced thermal and moisture conditions (WIACKOWSKI 1957). Hence, certain stratification in the beetles settling on stumps. *Hylastes ater*, *Hylastes opacus* and *Hylurgus ligniperda* usually prefer the lower part of the stump including the roots. The other species inhabit both the lower and the upper part. Frequently,



Table I. Abundance and percentages of Scolytidae species at all study sites.

No	Species	1-year-old culture		20-year-old stand		47-year-old stand		63-year-old stand		130-year-old stand		Total	
		abundance	percentage	abundance	percentage	abundance	percentage	abundance	percentage	abundance	percentage	abundance	percentage
1	<i>Hylurgops palliatus</i> (GYLL.)	167	23.07	2	0.68	29	4.08	46	3.85	8	0.62	252	5.97
2	<i>Hylastes ater</i> (PAYK.)	130	17.96	4	1.37	15	2.11	13	1.09	19	1.46	181	4.29
3	<i>Hylastes opacus</i> ER.	203	28.04	11	3.75	17	2.39	19	1.59	9	0.69	259	6.13
4	<i>Hylurgus ligniperda</i> (FABR.)	76	10.50	–	–	11	1.55	12	1.00	31	2.38	130	3.08
5	<i>Tomicus minor</i> (HART.)	–	–	–	–	5	0.70	27	2.26	43	3.31	75	1.78
6	<i>Tomicus piniperda</i> (L.)	119	16.44	123	41.98	149	20.96	151	12.63	121	9.31	663	15.70
7	<i>Pityogenes bidentatus</i> (HERBST)	–	–	83	28.33	61	8.28	79	6.61	53	4.08	276	6.53
8	<i>Pityogenes chalcographus</i> (L.)	–	–	–	–	4	0.56	20	1.67	15	1.15	39	0.92
9	<i>Pityogenes quadridens</i> (HART.)	–	–	15	5.12	18	2.53	30	2.51	19	1.46	82	1.94
10	<i>Pityogenes trepanatus</i> (NORDL.)	–	–	–	–	17	2.39	18	1.51	29	2.23	64	1.52
11	<i>Orthotomicus laricis</i> (FABR.)	21	2.90	12	4.10	35	4.92	20	1.67	9	0.69	97	2.30
12	<i>Orthotomicus proximus</i> (EICHH.)	–	–	–	–	11	1.55	37	3.09	21	1.62	69	1.63
13	<i>Orthotomicus suturalis</i> (GYLL.)	2	0.28	4	1.37	37	5.20	45	3.76	40	3.08	128	3.03
14	<i>Ips acuminatus</i> (EICHH.)	–	–	–	–	4	0.56	29	2.42	71	5.46	104	2.46
15	<i>Ips sexdentatus</i> (BORN.)	–	–	1	0.34	6	0.84	32	2.68	57	4.38	96	2.27
16	<i>Dryocoetes autographus</i> (RATZ.)	–	–	9	3.07	33	4.64	47	3.93	20	1.54	109	2.58
17	<i>Crypturgus cinereus</i> (HERBST)	1	0.14	5	1.71	53	7.45	171	14.30	219	16.85	449	10.63
18	<i>Crypturgus hispidulus</i> THOMS.	3	0.41	11	3.75	67	9.42	209	17.47	273	21.00	563	13.33
19	<i>Crypturgus pusillus</i> (GYLL.)	–	–	2	0.68	18	2.53	29	2.42	45	3.46	94	2.22
20	<i>Trypodendron lineatum</i> (OLIV.)	2	0.28	–	–	72	10.13	101	8.44	141	10.85	316	7.48
21	<i>Pityophthorus lichtensteini</i> (RATZ.)	–	–	7	2.39	31	4.36	40	3.34	37	2.85	115	2.72
22	<i>Pityophthorus pityographus</i> (RATZ.)	–	–	4	1.37	18	2.53	21	1.76	20	1.54	63	1.49
Total		724	100.00	293	100.00	711	100.00	1196	100.00	1300	100.00	4224	100.00



all of these species are seen on one stump. Thus, they may be said to constitute a characteristic community recorded also in other forest complexes (WIĄCKOWSKI 1957).

It was revealed that the accessory species of *Crypturgus cinereus* and *Crypturgus hispidulus* are not abundant (Tab. I). In their development, they use mother corridors of other *Scolytidae* including *Tomicus* sp. (NUNBERG 1984).

Associated with the young generation of pine are species of the genus *Hylastes* and *Hylurgops glabratus*, which eat bark (NUNBERG 1964).

The dominant species was *Hylastes opacus* (D = 28.04%), while *Hylurgus palliatus* (D = 23.07%), *Hylastes ater* (D = 17.96%), *Tomicus piniperda* (D = 16.44%) and *Hylurgus ligniperda* (D = 10.50%) functioned as subdominants. 10 species were recorded altogether. If we assume that the renewal took place soon after the removal of the stand, a thesis may be formulated that in the first year of culture development, the species composition of *Scolytidae* depends on the stumps.

15 species of *Scolytidae* were caught in the young stand of pine. The dominant species was *Tomicus piniperda* (D = 41.98%), which attacks the lowest and middle parts of the stem, while the subdominant was *Pityogenes bidentatus* (D = 28.33%), which inhabits the middle and top part of the stem.

In the 47- and 63-year-old pole wood, the species composition of *Scolytidae* was identical, while certain differences were noted in the structure of dominance. In the younger pole wood stand, *Tomicus piniperda* was the dominant species (D = 20.96%), while *Trypodendron lineatum* (D = 10.13%), which attacks the xylem, and *Crypturgus hispidulus* (D = 9.42%) and *Pityogenes bidentatus* (D = 8.28%), inhabiting the top part of the stem and branches at that stage, functioned as subdominants. In the older pole wood stand, *Crypturgus hispidulus* (D = 17.47%) was dominant, and the group of subdominants consisted of *Crypturgus cinereus* (D = 14.30%), *Tomicus piniperda* (D = 12.63%) and *Trypodendron lineatum* (D = 8.44%). 22 species of *Scolytidae* were caught in total.

The species composition in the mature stands was identical to that of the pole wood stands, while the structure of dominance was similar to that of the older pole wood stand. *Crypturgus hispidulus* was dominant again (D = 21.00%), while the group of subdominants comprised *Crypturgus cinereus* (D = 16.85%), *Trypodendron lineatum* (D = 10.85%) and *Tomicus piniperda* (D = 9.31%).

#### Ecological analysis

The highest value of Shannon and Weaver's index of species diversity was obtained for the pole wood *Scolytidae* communities (H = 3.9). The figure was a little lower (H = 3.7) for the mature stand community. These succession stages yielded the greatest number of species.

The young stand community lacked species associated with older stand e.g. *Hylurgus ligniperda*, *Tomicus minor*, *Orthotomicus proximus*, *Ips acuminatus*. The presence of 1 individual of *Ips sexdentatus* should be considered accidental; hence, a lower index of species diversity (H = 2.6).



The lowest species diversity was recorded for the culture stage, where the lowest number of species were caught. Some of the species associated with the pole wood and mature stands were not registered (*Tomicus minor*, *Orthotomicus proximus*, *Ips acuminatus*, *Ips sexdentatus*) and neither were certain species associated with young stands and the pole wood (*Dryocoetes autographus*, *Pityogenes bidentatus*, *Pityogenes quadridens*, *Pityogenes trepanatus*). One can conclude that the species composition of *Scolytidae* communities is stabilised in the pole wood stage and does not change afterwards.

## SUMMARY

The number of species in *Scolytidae* communities in different stages of secondary succession of a subcontinental (*Peucedano-Pinetum*) forest in Puszcza Białowieska has a minimum in the culture stage, and a maximum in the pole wood and mature stand. The number of species increases as the stand grows older to reach a maximum in the pole wood (this stage accommodates more than double the number of species known from the culture). *Hylurgops palliatus*, *Hylastes ater*, *Hylastes opacus*, *Tomicus piniperda*, *Crypturgus cinereus*, *Crypturgus hispidulus*, *Orthotomicus laricis* and *Orthotomicus suturalis* are constant species, found in every succession stage of the pine forest. *Tomicus*

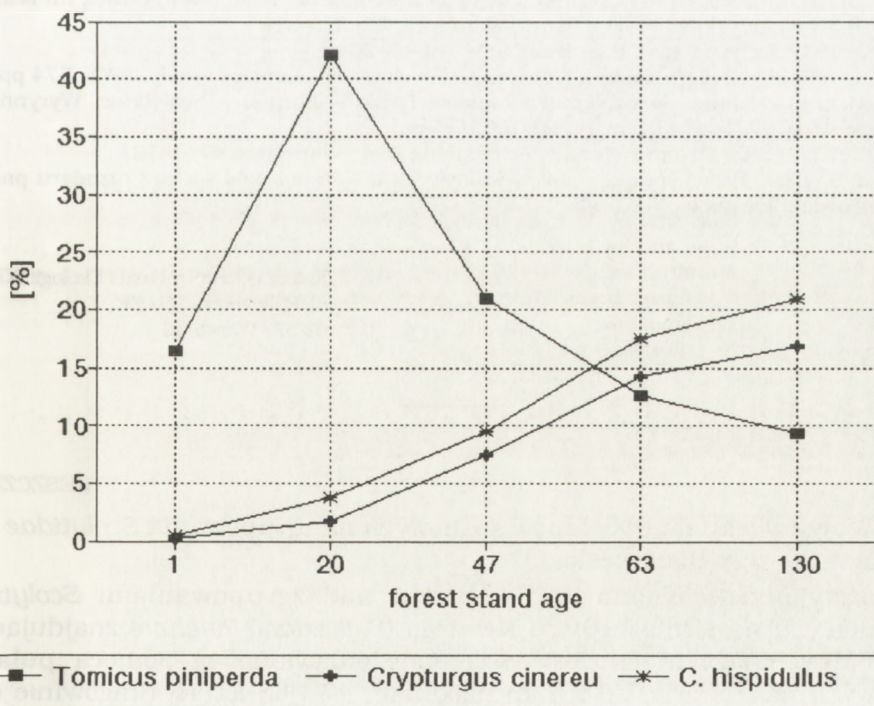


Fig. 1. The percentages of 3 species of *Scolytidae* in the consecutive age classes of the forest stand



*piniperda* is the dominant species (from  $D = 9.31\%$  in the mature stand to  $D = 41.98\%$  in the young stand). In the consecutive developmental stages of the stand, a steady increase was observed in the proportion of *Crypturgus cinereus* (from  $D = 0.14\%$  in the culture to  $D = 16.85\%$  in the mature stand) and *Crypturgus hispidulus* ( $D = 0.41\%$  and  $D = 21.00\%$  respectively) (Fig. 1).

The proportion of *Tomicus piniperda* increased from the culture stage ( $D = 16.44\%$ ) to the young stand (a maximum of  $D = 41.98\%$ ), to exhibit a steady fall ( $D = 9.31\%$  in the mature stand) afterwards (Fig. 1).

The abundance of the other species also varied in the consecutive age classes of the pine forest but did not follow an evident increasing or decreasing trend.

These *Scolytidae* communities from Puszcza Białowieska cannot be compared to other communities due to lack of data.

#### REFERENCES

- BALAŻY S., MICHALSKI J. 1964. Zespoły korników na tle typów drzewostanów Bieszczad. Pol. Pism. Entomol., Wrocław, ser. B, zeszyt 1-2, nr 11: 101-104
- BRAUNS A. 1964. Taschenbuch der Waldinsekten. Gustav Fischer Verlag, 817 pp.
- KARPIŃSKI J.J. 1933. Fauna korników puszczy Białowieskiej na tle występujących w puszczy typów drzewostanów. Zak. Dośw. Lasów Państw., Rozpr. i spraw., ser. A, nr 1: 68 pp.
- MATUSZKIEWICZ J.M., DEGÓRSKI M., KOZŁOWSKA A. 1993. Description of the plantassociation structure and soils of pine forest stands situated in five regions of Poland. *Fragm. Faun.*, Warsaw, 36: 13-36
- MICHALSKI J., RATAJCZAK E. 1989. Korniki (*Coleoptera: Scolytidae*) wraz towarzyszącą im fauną w Górach Świętokrzyskich. *Fragm. Faun.*, Warszawa, 32: 279-318
- NUNBERG M. 1947. Cetyńce. Inst. Bad. Leś., ser. C, nr 17, 20 pp.
- NUNBERG M. 1964. Uszkodzenia drzew i krzewów leśnych wywołane przez owady. PWN. 574 pp.
- NUNBERG M. 1981. Klucze do oznaczania owadów Polski - Korniki - *Scolytidae*, Wyrzyniki - *Platypodidae*. PWN. cz. XIX, zeszyt 99-100, 115 pp.
- TROJAN P. 1992. Analiza struktury fauny. *Memorabilia Zool.*, Warszawa, 47: 1-121
- WIĄCKOWSKI S. 1957. Entomofauna pniaków sosnowych w zależności od wieku i rozmiaru pniaka. *Ekol. Polska*, Warszawa, T V, nr 3: 1-140

Katedra Ochrony Lasu i Ekologii SGGW  
ul. Rakowiecka 26/30  
02-528 Warszawa

#### STRESZCZENIE

[Tytuł: Wpływ wieku drzewostanów sosnowych na zgrupowania *Scolytidae* (*Coleoptera*) w Puszczy Białowieskiej.]

W pracy przedstawiono wyniki badań nad zgrupowaniami *Scolytidae* występującymi na siedlisku boru świeżego (*Peucedano-Pinetum*) znajdującego się w różnych fazach sukcesji. *Scolytidae* odławiano za pomocą pułapek ekranowych na uprawie, 20-letnim młodniku, 47 i 63-letniej dragowinie oraz 130-letnim starodrzewiu. Zebrano łącznie 4224 egzemplarze *Scolytidae* należące

do 22 gatunków (tab. 1). Najmniejszą różnorodnością gatunkową charakteryzowała się uprawa (10 gat.), największą obie dragowiny i starodrzew (po 22 gat.). Najbardziej podobną strukturę gatunkową i ilościową zaobserwowano w dragowinie starszej i starodrzewiu.

Na uprawie gatunkiem dominującym był *Hylastes opacus*, w młodniku i 47-letniej dragowinie – *Tomicus piniperda*, a w 63-letniej dragowinie i starodrzewiu *Crypturgus hispidulus*. W przypadku dwóch gatunków (*Crypturgus cinereus* i *C. hispidulus*) wykazano tendencję wzrostową ich udziału w zgrupowaniach Scolytidae w miarę rozwoju drzewostanu (rys. 1). Udział *Tomicus piniperda* wzrastał od uprawy do młodnika (gdzie osiągnął maksimum), a następnie systematycznie spadał (rys.1). Pozostałe gatunki nie wykazywały wyraźnych tendencji wzrostowych czy malejących w poszczególnych klasach wiekowych boru świeżego. Stwierdzono wysoki procent gatunków stałych, występujących we wszystkich fazach rozwojowych drzewostanu (8 gat. na 22 zebranych ogółem).

---