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Changes in the carabid fauna of Polesie peat-bog due to drainage, ploughing and agricultural development

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Abstract. The changes over a 20-year period (1975-1995) in the carabid fauna of a peat bog (situated at the lowland of the Bobryk River, a tributary of the Prypiat River in Belarus) under the influence of drainage and agricultural development were examined. The number of species decreased a year after drainage from 67 to 50. After 10 years, the number of species increased to 55, and after 20 years - to 69. The number of narrowly distributed species was decreased, and the widespread holarctic and palearctic species dominated. The significant changes in species composition and the structure of domination were found.

Key words: Carabidae, peat bog, drainage melioration, agricultural development.

INTRODUCTION

Nearly 130 years ago, the drainage melioration of Polesie peat bog started. By 1983, 618 800 ha of swamps had been drained (Maslowski, 1984). Independent experts assessed the real area of decreased level of ground water to be four times more (nearly 2.7 million ha). Currently, most of the Polesie lowland is a new arable landscape with a unique mosaic of natural swamps, rivers, and lakes. Some effects of drainage melioration on the soil fauna have been examined in Belarus in the works by: Gorbunova (1956), Kipenvarlitz (1961), Aleksandrovich, Yakimovich (1979), Khotko et al. (1980). The major characteristics of carabid fauna transformation were found to be the decreasing number of species and the abundance of specimens. However, detailed data and complete species lists have not yet been published.

MATERIALS AND METHODS

A long-term study of carabid fauna changes under the influence of drainage melioration and the agricultural development of bottom peat bogs was earned out between 1975-1995 in the area of Luninetz, in the Brest district of Belarus (52°14'26" N, 26° 3732" E). The drainage melioration of the southern part of the peat bog was started in 1971. The northern fragment of the peat bog was ditched in 1975 and grazed in 1976. The drained peat bog was stumped and ploughed in the late autumn of 1976 and since 1977 it has been used as arable land (barley fields in 1977, 1985, 1995). The study was conducted in 1975--1977, 1985 and 1995 on the same area of 60 ha.

For the collection of carabids, glass pitfall traps were used (volume 500 ml, diameter 72 mm) with a formalin solution (4%). The 20 traps were placed in two lines (the distance between

traps was about 10 meters). The traps were changed after 7-10 days. Pitfall trapping was started in the first half of April and all traps were removed at the beginning of November. For calculating the distribution characteristics, standard statistical procedures were used.

The structural heterogeneity of the communities was expressed in variations of species structure. To estimate the collections' statistical diversity the Shannon-- Weaver diversity formula (Shannon, Weaver 1949) was used:

$H' = - \ p_i \ln p_i$

The standard error of the diversity measure (m_{Hj}) was calculated using the Hutcheson (1970) formula:

$m^2_{Hj} = l/N[l/N(N\ln^2 N - \ n_j \ln^2 n_j) - (H')^2 + (S - 1)/2N^2 + ...]$

The index of the dominant concentration was also calculated using the Simpson formula (1949):

$C^2 = \ (p_i)^2$

Where in all cases p_i - share of a species n_j in a collection of volume N.

Subsequent cluster analysis was employed in the analysis of carabid fauna transformation.

RESULTS AND DISCUSSION

In total, 12.378 ground beetles from 110 species were collected from 1975--1995 (Tab. 1).

Number of specimens and activity. The total numbers of the collected carabids decreased significantly ($P < 0.05$) from 3841 in peat bog in 1975 to 2513 in ditch peat bog in 1976. In barley in 1977, the total number collected increased significantly to the level of 1975, and further total numbers collected decreased significantly in 1985 and 1995. The difference between the total number collected in 1985 and 1995 was not significant. In 1976, a year after drainage melioration, the activity of the carabids decreased from 0.91 ±0.06 to 0.60 ±0.08 specimens/trap per day. After ploughing and agricultural development of the drainage peat bog in 1977, the carabid activity increased slightly, and after 10 and 20 years it had been halved (from 0.78±0.09 in 1977 to 0.27±0.11 in 1985 and to 0.46±0.10 specimens/trap per day in 1995).

Number of species. After the ditching in 1975, the number of species increased from 50 to 67 in 1976. A year after ploughing, the number of species had decreased to 50, and in 1985 it had increased to 56. In 1995 69 species were found in barley (Tab. 1).

Species diversity. During each stage of melioration and agricultural development in 1975-1995, transformation of the carabid composition was observed. The value of Shannon-Weaver Index (H') decreased significantly from 2.79 ±0.04 in peat bog to 2.54 ±0.03 ($P < 0.05$) after the ditching in 1976. The next decrease was registered after ploughing in 1977 to the level of 2.39 ±0.05, and 2.31 ±0.05 in 1985 and 2.49 ±0.06 in 1995. During the first year after development in 1977, and again in 1985 and 1995, no significant differences were found. The dominant concentration *C* in carabid compositions varied from 0.12 in peat bog to 0.19 in drained bog and barley in 1976-1977 to 0.12 in 1985 and 0.15 in 1995.

In general, in comparison to peat bog carabid composition, the value of the variety index decreased and the dominant concentration increased. This shows the radical changes in carabid composition and, above all, in the structure of domination.

Dominant species. The structure of domination completely changed. After ditching, such dominant hygrophilous peat bog species as *Carabus granulatus, Epaphius rivularis, Carabus menetriesi, Pterostichus nigrita,* and subdominants *Pterostichus minor, P. diligens* **,** *Oxypselaphus obscurus***,** *Oodes helopioides* became recedent, and subdominant *Patrobus assimilis* disappeared. In the carabid compositions new dominants appeared: *Poecilus versicolor, Amara communis, Amara famelica, Pterostichus vernalis, and Dyschiriodes globosus,* known as typical meadow species (Tab. 1).

After ploughing in 1977, certain changes in the structure of domination were observed: the mesophilous meadow species *Amara communis, A. famelica* moved from the dominant to the

recedent mesophilous eurybiont *Pterostichus melana rius.* From the subdominant to the recedent moved the mesohygrophilous meadow species *Dyschirius globosus* and the hygrophilous peat bog species *Pterostichus diligens.*

The stenobiont hygrophilous peat bog species *Epaphius rivularis, Patrobus atrorufus, Europhilus fuliginosus, Trichocellus placidus, Badister sodalis,* and the mesophilous forest species *Epaphius secalis, Platynus krynickii, P. assimilis, Harpalus latus* disappeared.

During the first year after ploughing, new dominants and subdominants appeared. They were the field species: mesohygrophilous *Loricera pilicornis,* mesophilous *Clivina fossor, Pseudoophonus rufipes, Bembidion properans, Poecilus cupreus, Amara fulva* (Tab. 1).

In 1985 the group of dominant included *Poecilus versicolor, Amara familiaris, Poecilus cupreus, Clivina fossor, Loricera pilicornis,* and in 1995 such species as *Poecilus versicolor, P. cupreus, Loricera pilicornis, Calathus melanocephalus, Bembidion quadrimaculatum, B. properans* were dominant in barley.

Thus, after 10-20 years the dominant group appeared in typical field species.

Zoogeographical note. The carabid compositions were generated at the expense of 5 zoogeographical elements. In 1975, the peat bog was predominated by West-Central Palaearctic (17 species, 32.33% specimen), West Palaearctic (12 species, 20.14% specimen), and Transeurasian (11 species, 38.78% specimen) elements (Tab. 2). After drainage in 1976, the number of species and abundance of West-Central Palaearctic elements doubled. The abundance of West Palaearctic and Transeurasian elements decreased. The fauna of the drained bog was enriched at the expense of Holarctic and West-Central Palaearctic elements. What is more, such Transeurasian xerophilous species as *Anisodactylus signatus* and *Harpalus froelichii* appeared, along with Euro--Kazakhstan species such as *Amara chaudoiri chaudoiri.*

In the drained bogs, the carabid fauna was practically reformed. The ratio of initial bog species was sharply reduced and eventually disappeared. The source of the new composition came from nearby dry meadows and fields with sandy soils. No essential changes in zoogeographical structure after the ploughing and agricultural development were found (Tab. 2). Ten and twenty years after drainage melioration, the numbers of typical field Holarctic and West-Central Palaearctic species increased.

Thus, after drainage and agricultural development over 20 years, a consecutive transformation of carabid fauna was observed. The species with narrow West Palaearctic areals were reduced in number, and widespread Holarctic and Palaearctic elements predominated.

Hygropreferendum groups. The humidity of the environment is the leading limiting factor for carabids. According to C. Lindroth (1945) in a composition of carabids of peat bog, 5 groups with various types of hygropreferendum were allocated. In peat bog, hygrophilous species predominated. Immediately after drainage, the number of hygrophilous species and specimens decreased from 92.68 to 15.27% (Tab. 2). The number of species and abundance of specimens of mesophilous and mesohygrophilous species increased, including the appearance of mesoxerophiloius and xerophiloius species. Over 10-20 years, mesophilous species had prevailed.

Over 20 years of agricultural development, the abundance of hygrophilous and mesohygrophilous species decreased to 15.49%. These fluctuations are undoubtedly the consequences of the dramatic changes in the microclimate of the drained bogs. Over 10-20 years, mesoxerophilous and xerophilous species appeared such as *Poecilus punctu latus, Calathus erratus, C. ambiguus, Amara curta, A. eurynota, A. apricaria, Harpalus luteicornis, H. affinis, H. distinguendus.* They are common in meadows and fields with sandy soils. The abundance and the number of mesoxerophilous and xerophilous species appreciably increased in 20 years: for mesoxerophilous up to 13 species and 4.80%, and for mesoxerophilous up to 6 species and 2.12% (Tab. 2).

Seasonal groups. In peat bog, spring breeders before and after the drainage was prevalent (Tab. 2). Among the autumn breeders the beetle of *Epaphius rivularis, Leistus terminatus,*

Pterostichus niger, P. melanarius, and Calathus melanocephalus were found, all capable of surviving in the vegetative residues on the bog's tussocks.

A low winter temperature kills the owerwintering larval stages at peat bogs (Krogerus, 1939). As a result, in the native peat bog and drained bogs, the number of species and percentage of species with autumn breeding is low.

After an analysis of changes in the distribution of carabids in the drained peat bog according to breeding type, an increase in the number of species with autumn breeding was found (Tab. 2).

On the fields 10 and 20 years after drainage, the number of species with spring breeding did not significantly change. In 1977, the first year after ploughing, the number of *Pseudoophonus rufipes* (species with main autumn breeding) sharply increased. It was a possible effect of migration. After 10 and 20 years, the number of *P. rufipes* decreased, probably due to the adverse conditions for the development of larvae.

There was also an increase in the abundance of species with autumn breeding over the 20-year period, especially *Calathus melanocephalus,* whose larvae are probably capable of enduring low winter temperatures in drained bogs.

Habitat groups. Samples of peat bog, riparian, meadow, forest and field groups were found in the native peat bog. The inhabitants of bogs (32 species, 85.12% of specimens) and meadows (9 species, 8.12% of specimen) were predominant (tab. 2). Stenobiont peat bog species, such as *Pterostichus aterrimus, Patrobus assimilis, Oxypselaphus obscurus, Europhilus thoreyi, Europhilus gracilis, Elaphrus cupreus, Dyschiriodes tristis, Chlaenius tristis, Bembidion guttula, Bembidion articulatum, Acupalpus exiguus,* and *Acupalpus brunnipes* disappeared after drainage.

After ploughing and agricultural development, the number of peat bog species was reduced to 12, and was practically constant. The share of peat bog species in composition was reduced from 8.96 % in 1977 up to 2.99 % in 1995. Directly after drainage, the number and abundance of meadow species such as *Poecilus versicolor, Amara communis, Amara famelica, Pterostichus vernalis, Dyschiriodes globosus* (tab. 1) increased. The number of meadow species and specimens appreciably varied on fields of barley in 1977-1995.The forest and riparian species were not numerous. Such forest species as *Pterostichus strenuus, P. oblongopunctatus, P. niger, Platynus assimilis, Harpalus latus,* and riparian species such as *Cicindela hybri da, Bembidion obliguum, Bembidion femoratum, Dyschiriodes politus* and *Agonum impressum* had only isolated specimens on the arable fields between 1977-1995.

Trophic groups. The predatory species of carabids were practically only found in their native bog. The numbers of predatory species was reduced after drainage (tab. 2). After ploughing, the numbers of predatory species decreased, but their numbers increased. In the fields of barley from 10 and 20 years after drainage the numbers of predatory species increased and the number of specimens varied from 73-84 %. The species with the mixed feeding became numerous only after drainage. These included species from the genus *Amara, Harpalus* and *Anisodactylus.* The numbers of species of mixophagous increased after drainage from 20 to 28 species. Their number varied from 16-24%. Saprophagous (*Stenolophus, Dicheirotrichus, Acupalpus*) were not numerous, and their numbers were also reduced after drainage and ploughing to individual specimens.

During the first year after drainage, the abundance of zoophages geobionts species living in ground (*Dyschiriodes, Clivina*) was increased. The geobionts' abundance grew after ploughing also. In one year after ploughing it was increased to 13.94%, but it was decreased in 10 years to 11.49%, and through 20 years up to 1.27%. The number of geobionts species increased after ploughing due to occurrence *Broscus cephalotes.*

The abundance of zoophages litter stratobionts species living in the litter (*Bembidion, Agonum, Pterostichus*) reduced twice after drainage and ploughing (Tab. 1, 2).

The abundance of myxophytophages litter stratobionts was increased up to 20.88% in 10 years due to high number of *Amara familiaris.* The abundance of zoophages litter stratobionts was

increased up to 37.68% in 20 years due to occurrence of the field species (*Bembidion properans, Bembidion quadrimaculatum, Loricera pilicornis, Calathus melanocephalus*).

The number of species of zoophages and myxophytophages litter stratobionts was decreased at once after ploughing from 33 up to 21, and was increased up to 28 in 20 years only.

The abundance of zoophages digger stratobionts species living in the litter and top layer of ground (*Poecilus, Pterostichus melanarius, Pterostichus niger*) was increased considerably after drainage and ploughing (Tab. 1, 2). The number of species of digger stratobionts remained practically constant.

The abundance and number of digger hortobionts species living in the top layer of ground and capable to climb on the plants (*Harpalus, Pseudophonus, Amara* (*Zezea*)) increased after drainage. However their abundance and number of species were decreased from 21.58 to 6.46% after ploughing. The abundance was increased through 10 and 20 years up to 10.16%, and the number of species was increased from 9 up to 21.

The abundance and number of litter hortobionts species living in litter and capable to climb on the plants *(Amara)* increased after drainage. The maximum of their abundance (10.84%) was observed in one year after ploughing. Their abundance varied (2.13-4.61%) after 10 and 20 years.

Cluster analysis. A subsequent cluster analysis revealed that the greatest similarity was in carabid composition in barley fields 1 and 10 years after development, and the least similarity in the carabid composition of drained peat-bog and of 20-year arable land (Fig. 1). The carabid fauna of the native peat bog is considerably different. Its similarity with a drained peat bog and the arable fields is the lowest. Hence, drainage and agricultural development are independent processes. The drainage of peat bogs is conducive to the formation of essentially new carabid composition, with a prevalence of mesophilous meadow species. In the drained peat bog, the numbers of ecological niches increased. It is conducive to the expansion of meadow and field species, as predator and mixophagous. As a consequence, the Shannon-Weaver diversity is reduced and increases the concentration of domination related to the general reduction of the abundance.

CONCLUSIONS

After drainage and agricultural development over 20 years, a consecutive transformation of carabid fauna was observed. The species with narrow West Palaearctic areals were reduced in number, and the widespread Holarctic and Palaearctic elements predominated. The drainage of bottom-bogs was conducive to the formation of essentially new carabid fauna, with a prevalence of meadow mesophilous species with spring breeding and overwintering beetles. In the drained peat bogs the numbers of ecological niches increased. It is conducive to the expansion of myxophytophages digger hortobionts, zoophages geobionts and litter stratobionts, but reduction of abundance of zoophages epigeobionts. As a consequence, the variety of the Shannon-Weaver parameters was reduced and increased the concentration of domination.

The main effects of drainage are the increasing numbers of species. The stenobiont epigeobiont hygrophilous peat bog species is substituted by meadow mesophilous litter stratobionts species. The ploughing and agricultural development of the drained peat bog is conducive to the transformation of the carabid fauna of wet meadow into arable field species with a prevalence of field mesophilous digger species: zoophages stratobiont, and myxophytophages hortobiont. The abundance of carabids is reduced up to 30% after drainage, and it is further reduced by almost half after 20 years.

Thus, after 20 years of drainage and agricultural development of the peat bog of Polesie, changes in the species composition and structure of domination have occurred. The common xerophilous steppen species were also recorded. It is necessary to take into account that the spring spraying of fields with pesticides in the peat-bog soils caused a reduction in the number of dominant species with spring breeding. It is conducive to the depression of the carabid community as a whole, because species active in the second half of the summer are small in number in drained peat-bog soils.

This feature of carabid composition in drained peat-bog soils should be taken into account during the planning of agricultural development, as the reduction of the number of the most common predators inevitably will increase the number of pests.

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SUMMARY

The changes over a 20-year period (1975-1995) in the carabid fauna of a peat bog under the influence of drainage and agricultural development were examined. The peat bog is situated on the lowland of the Bobryk River, a tributary of the Prypiat River in the Luninetz area of the Brest district of Belarus (52°14'26" N. 26° 37'32" E). The peat bog was ditched in 1975 and grazed in 1976. The drained peat bog was stumped and ploughed in the late autumn of 1976 and since 1977 it has been used as arable land (barley fields in 1977.1985. 1995). The study was conducted in 1975--1977, 1985 and 1995 on the same area of 60 ha.

After drainage and agricultural development over 20 years, a consecutive transformation of carabid fauna was observed. The number of species decreased a year after drainage from 50 to 67 in 1975. However, after ploughing in 1977 it decreased from 67 to 50. After 10 years, the number of species increased to 55. and after 20 years it increased to 69.

The species with narrow West Palaearctic areals were reduced in number, and the widespread Holarctic and Palaearctic elements predominated. The drainage of bottom-bogs was conducive to the formation of essentially new carabid fauna, with a prevalence of meadow mesophilous species with spring breeding and overwintering beetles. In the drained peat bogs the numbers of ecological niches increased. It is conducive to the expansion of myxophytophages digger hortobionts, zoophages geobionts and litter stratobionts, but reduction of abundance of zoophages epigeobionts. As a consequence, the variety of the Shannon-Weaver parameters were reduced and increased the concentration of domination.

The main effects of drainage are the increasing numbers of species. The stenobiont epigeobiont hygrophilous peat bog species is substituted by meadow mesophilous litter stratobionts species. The ploughing and agricultural development of the drained peat bog is conducive to the transformation of the carabid fauna of wet meadow into arable field species with a prevalence of field mesophilous digger species: zoophages stratobiont, and myxophytophages hortobiont. The common xerophilous steppen species were also recorded. The abundance of carabids is reduced up to 30% after drainage, and it is further reduced by almost half after 20 years.

TABLE 1. The species composition and structure of domination in carabid's community on a peat-bog before and after draining. Belarus, Lunitetz area, 1975-1995

Species	Native peat-bog, 1975	Drained peat-bog, 1976	Barley 1977	Barley, 1985	Barley, 1995
Carabus granulatus Linnaeus, 1758	30.43	0.62	0.67	2.01	0.28
Epaphius rivularis (Gyllenhal, 1810)	10.62	0.12	0	0	0
Pterostichus nigrita (Paykull, 1790)	6.06	2.07	0.04	2.27	0.28
Carabus menetriesi Hummel, 1827	5.51	0.06	1.16	0.13	0.03
Patrobus assimilis Chaudoir, 1844	4.96	0	0	0	0
Pterostichus minor (Gyllenhal, 1827)	4.88	0.9	0.49	0.27	0.23
Oxypselaphus obscurus (Herbst, 1784)	4.17	0	0	0	0
Pterostichus diligens (Sturm, 1824)	4.01	3.77	1.74	1.07	0.15
Oodes helopioides (Fabricius, 1792)	4.01	0.77	0.09	0.53	0
Pterostichus anthracinus (Illiger, 1798)	2.2	0.28	1.21	0.27	0.51
Leistus terminatus Panzer, 1793	2.2	0.19	0	0	0.03
Loricera pilicornis (Fabricius, 1775)	1.97	0.99	5.49	6.42	9.71
Patrobus atrorufus (Strø m, 1768)	1.81	0.77	0	0	0
Carabus clathratus Linnaeus, 1761	1.42	0.28	0	0	0
Pterostichus niger (Schaller, 1783)	1.34	0.56	0	0.13	0.15
Pterostichus melanarius (Illiger, 1798)	1.33	3.89	2.95	0.67	0.64
Bembidion doris (Panzer, 1797)	1.26	0.59	0	0	0
Pterostichus strenuus (Panzer, 1797)	1.18	1.42	0.27	0.27	0.05
Elaphrus cupreus Duftschmid, 1812	1.18	0	0	0	0
Europhilus fuliginosum (Panzer, 1809)	1.02	0.06	0	0	0
Dyschiriodes globosus Herbst, 1784	0.87	4.36	1.83	1.6	0.15
Platynus krynickii (Sperk, 1835)	0.63	0.25	0	0	0
Blethisa multipunctata (Linnaeus, 1758)	0.63	0	0.04	0	0
Bembidion articulatum (Panzer, 1792)	0.63	0	0	0	0
Bembidion guttula (Fabricius, 1792)	0.63	0		0	0
Notiophiluis palustris (Duftschmid, 1812)	0.55	0.19	0.04	0	0.05
Agonum afrum (Duftschmid, 1812)	0.39	2.26	0	0.27	0.28
Amara plebeja (Gyllenhal, 1810)	0.31	0.12	0.76	0.13	1.17
Badister sodalis (Duftschmid, 1812)	0.31	0.09	0	0	0
Stenolophus mixtus (Herbst, 1784)	0.31	0.03	0.04	0	0
Pterostichus ob longopunctatus (Fabricius, 1787)	0.31	0	0.04	0	0.1
Platynus livens (Gyllenhal, 1810)	0.31	0	0	0	0
Acupalpus exiguus (Dejean, 1829)	0.24	0	0	0	0

Dyschiriodes tristis (Stephens, 1827)	0.24	0	0	0	0
Poecilus versicolor (Sturm, 1824)	0.16	40.33	38.84	28.50	32.74
Amara communis (Panzer, 1797)	0.16	13.08	0.31	1.74	2.41
Pterostichus vernalis (Panzer, 1796)	0.16	2.47	4.96	2.14	1.25
Anisodactylus binotatus (Fabricius, 1787)	0.16	0.59	1.38	2.01	0.23
Pterostichus gracilis (Dejean, 1828)	0.16	0.25	0.89	0.53	0.05
Platynus assimilis (Paykull, 1790)	0.16	0.19	0	0	0
Pterostichus rhaeticus Heer, 1838	0.16	0.03	0	0	0
Chlaenius tristis (Schaller, 1783)	0.16	0	0	0	0
Europhilus gracilis Sturm, 1824	0.16	0	0	0	0
Europhilus thoreyi (Dejean, 1828)	0.16	0	0	0	0
Calathus melanocephalus (Linnaeus, 1758)	0.08	1.08	0.27	1.34	8.92
Acupalpus parvulus (Sturm, 1825)	0.08	0.56	0	0	0
Bradycellus caucasicus (Chaudoir, 1846)	0.08	0.53	0.09	0	0
Acupalpus brunnipes (Sturm, 1825)	0.08	0	0	0	0
Bembidion obliguum Sturm, 1825	0.08	0	0	0	0
Pterostichus aterrimus (Herbst, 1784)	0.08	0	0	0	0
Amara famelica Zimmermann, 1832	0	6.18	0.67	0.94	0.43
Clivina fossor (Linnaeus, 1758)	0	1.67	12.1	9.76	1.07
Bembidion properans (Stephens, 1828)	0	1.67	3.44	2.14	6.28
Synuchus vivalis (Illiger, 1798)	0	1.02	0	0.27	0.33
Agonum sexpunctatum (Linnaeus, 1758)	0	0.77	1.03	1.6	0.1
Amara familiaris (Duftschmid, 1812)	0	0.77	0.27	11.98	0.36
Curtonotus aulicus (Panzer, 1797)	0	0.65	0	0.53	0.3
Pseudoophonus rufipes (De Geer, 1774)	0	0.62	9.87	0.8	2.54
Amara aenea (DeGeer, 1774)	0	0.53	0	0.4	0.66
Amara chaudoiri Schaum, 1858	0	0.28	0.04	0	0
Poecilus cupreus (Linnaeus, 1758)	0	0.22	3.04	8.9	9.52
Amara spreta Dejean, 1831	0	0.22	0	0	1.78
Amara bifrons (Gyllenhal, 1810)	0	0.15	0.27	0.8	1.17
Microlestes minutulus (Goeze, 1777)	0	0.15	0.18	0.13	0.05
Anisodactylus signatus (Panzer, 1797)	0	0.15	0.13	0.67	0.23
Bembidion quadrimaculatum (Linnaeus, 1761)	0	0.15	0.13	1.34	9.83
Chlaenius nigricornis (Fabricius, 1787)	0	0.15	0.04	0.13	0.08
Bembidion femoratum Sturm, 1825	0	0.15	0	0.67	0.03
Trechoblemus micros (Herbst, 1784)	0	0.12	0	0.13	0
Europhilus micans (Nicolai, 1822)	0	0.09	0	0	0
Amara similata (Gyllenhal, 1810)	0	0.06	0.22	0.94	0.33
Asaphidion flavipes (Linnaeus, 1761)	0	0.06	0.04	0.67	0
Harpalus froelichi Sturm, 1818	0	0.06	0.04	0.53	0.64
Dicheirotrichus placidus (Gyllenhal, 1827)	0	0.06	0	0	0

Syntomus truncatellus (Linnaeus, 1761)	0	0.06	0	0.13	0
Cicindela hybrida Linnaeus, 1758	0	0.03	0.18	0	0
Amara nitida Sturm, 1825	0	0.03	0	0	0
Amara tibialis (Paykull, 1798)	0	0.03	0	0	0.36
Amara tricuspidata Dejean, 1831	0	0.03	0	0	0.03
Diachromus germanus (Linnaeus, 1758)	0	0.03	0	0	0
Harpalus latus (Linnaeus, 1758)	0	0.03	0	0	0
Harpalus tardus (Panzer, 1797)	0	0.03	0	0.13	0.15
Notiophilus aquaticus (Linnaeus, 1758)	0	0.03	0	0	0.03
Amara fulva (Müller, 1776)	0	0	2.95	0.67	0.05
Agonum impressum (Panzer, 1797)	0	0	0.71	0.13	0.08
Amara majuscula Chaudoir, 1850	0	0	0.49	0.53	0.71
Calosoma auropunctatum (Herbst, 1784)	0	0	0.18	0.53	0.23
Harpalus affinis (Schrank, 1781)	0	0	0.13	0.13	0.64
Amara lunicollis Schiodte, 1837	0	0	0.09	0	1.07
Agonum gracilipes (Duftschmid, 1812)	0	0	0.04	0.13	0.08
Agonu m lugens (Duftschmid, 1812)	0	0	0.04	0	0
Bembidion lampros (Herbst, 1784)	0	0	0.04	0	0
Pseudoophonus calceatus (Duftschmid, 1812)	0	0	0.04	0.13	0.51
Acupalpus meridianus (Linnaeus, 1767)	0	0	0	0	0.23
Amara apricaria (Paykull, 1790)	0	0	0	0.27	0.05
Amara curta Dejean, 1828	0	0	0	0	0.08
Amara eurynota (Panzer, 1797)	0	0	0	0.27	0.05
Amara ovata (Fabricius, 1792)	0	0	0	0	0.05
Anchomenus dorsalis (Pontoppidan, 1763)	0	0	0	0.13	0.03
Asaphidion pallipes (Duftschmid, 1812)	0	0	0	0	0.03
Bembidion assimile Gyllenhal, 1810	0	0	0	0	0.03
Broscus cephalotes (Linnaeus, 1758)	0	0	0	0.13	0
Calathus ambiguus (Paykull, 1790)	0	0	0	0.13	0.03
Calathus erratus (Sahlberg, 1827)	0	0	0	0	0.03
Calosoma investigator (Illiger, 1798)	0	0	0	0	0.03
Dyschiriodes politus Dejean, 1825	0	0	0	0	0.05
Harpalus distinguendus (Duftschmid, 1812)	0	0	0	0.13	0.05
Harpalus luteicornis (Duftschmid, 1812)	0	0	0	0	0.1
Harpalus rubripes (Duftschmid, 1812)	0	0	0	0	0.05
Poecilus punctulat us (Schaller, 1783)	0	0	0	0.8	0.03
Abundance, specimens/trap/day $\pm S_x$	0.91	0.60	0.78	0.27	0.46
	±0.06	±0.08	±0.09	±0.11	±0.10
Number of species	50	67	50	56	69
Number of specimens	3841	2513	2940	1149	1935
Shannon-Weaver' index H' $\pm m_h$.	2.79	2.54	2.39	2.31	2.49
	±0.03	±0.03	±0.03	±0.05	±0.02
Simpson' Index of dominancy C	0.12	0.19	0.19	0.12	0.15

TABLE 2. Changes of ecological structure of peat bog's Carabidae (1975), plough up (1976), and agricultural management (1977, 1985 Luninetz region, Brest district assembly under draining , 1995). Polesskij village

ECOLOGICAL GROUP	Native peat bog, 1975		Drained peat bog, 1976		Barley, 1977		Barley, 1985		Barley, 1995	
	Number of species	Specimen, %	Number of species	Specimen, %	Number of species	Specimen, %	Number of species	Specimen, %	Number of species	Specimen, %
ZOOGEOGRAFICAL COMPLEX										
Holarctic	5	7.8	8	9.79	11	24.32	9	33.77	12	28.73
Transeurasian	11	38.78	12	17.8	13	13.77	12	11.48	16	10.07
Euro-Siberian	17	32.33	29	61.85	14	50.93	20	42.27	26	47.91
West-Central Palaearctic	5	0.95	6	4.35	6	6.96	7	6.82	8	11.73
West Palaearctic	12	20.14	12	6.21	6	4.02	8	2.66	7	1.56
HYGROPREFERENDUM GROUPS										
Hygrophilous	36	92.68	24	15.27	14	12.65	13	14.7	15	12
Mesohygrophilous	6	3.31	11	16.28	8	10.94	9	9.49	10	3.49
Mesophilous	8	4.01	18	65.59	18	72.41	17	70.37	25	77.59
Mesoxerophilous			10	2.09	6	3.61	10	2.65	13	4.8
Xerophilous			4	0.77	4	0.39	7	2.79	6	2.12
SEASONAL GROUPS										
Autumn breeders	5	15.57	10	7.81	8	16.88	14	6.53	15	15.83
Spring breeders	45	84.43	57	92.19	42	83.12	42	93.47	54	84.17
LIFE FORMS										
ZOOPHAGES:	42	98.58	43	75.18	32	82.21	36	67.37	40	83.57
Epigeobionts	5	39.17	5	1.05	6	2.27	4	3.34	5	0.6
Geobionts	2	1.11	2	6.03	2	13.93	3	11.49	3	1.27
Litter stratobionts	26	46.5	28	20.47	17	19	22	19.37	23	37.68
Digger stratobionts	9	11.8	8	47.63	7	47.01	7	33.17	9	44.02
MYXOPHYTOPHAGES:	8	1.42	24	24.82	18	17.79	20	32.63	29	16.43
Digger hortobionts	2	0.32	12	21.58	9	6.46	15	9.62	21	10.16
Litter hortobionts	1	0.31	7	1.29	5	10.84	4	2.13	5	4.61
Litter stratobionts	5	0.79	5	1.95	4	0.49	1	20.88	3	1.66
HABITAT GROUPS										
Field	3	3.38	17	12.97	18	41.78	28	39.63	32	54.84
Meadow	9	8.12	20	67.99	15	48.02	13	52.23	19	41.71
Forest	4	2.99	4	2.20	2	0.31	2	0.40	3	0.30
Peat bog	32	85.12	23	16.63	12	8.96	11	6.94	12	2.99
Riparian	2	0.39	3	0.21	3	0.93	2	0.80	3	0.16
NUMBER OF SPECIES	50		67		50		56		69	
NUMBER OF SPECIMEN		3841		2513		2940		1149		1935

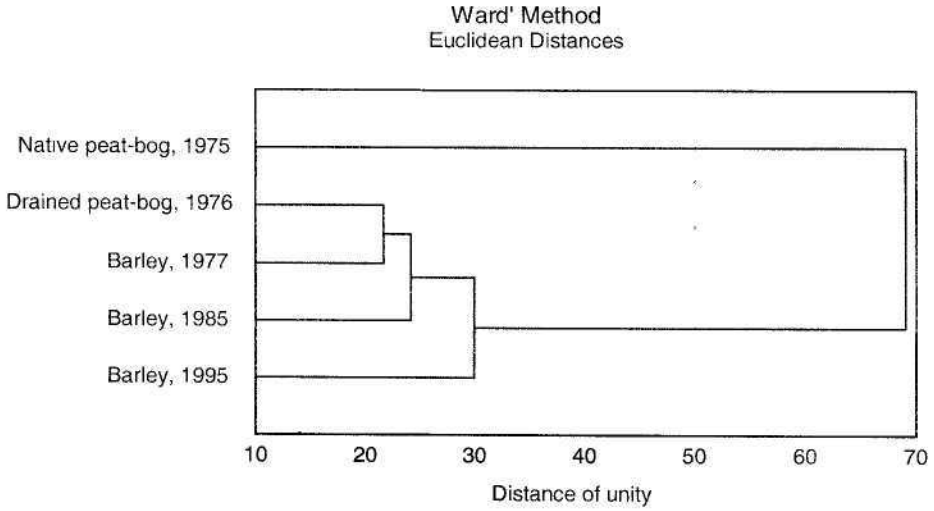

FIGURE. Dendrogram of similarity of Carabidae peat bog's assemblies